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AN INTERESTING EXPERIMENT IN RECHARGING DRY CELLS.

Every now and then some enthusiastic thinker or untiring experimenter hits upon or tries the interesting experiment of recharging dry cells. If dry cells were made in small quantities and sold at a high price, such a proceeding might be called sensible, but generally it is worse than a waste of time and energy.

In a recent issue of a popular journal an experiment of this kind is described, the experimenter being pleased to find that after a few minutes' charge his cells would give "a fairly strong current." Naturally, if a short charge accomplished some wonderful results, a longer charge produced still better ones, so he proceeded to continue the work of charging, and was somewhat chagrined, after several hours, to find that his cells had gone all to pieces. He was not, however, one who was easily discouraged, for he immediately procured a new lot of batteries and started over again to see why the trouble had happened. This time the charge was stopped before the batteries had gone to pieces, and after removing the belt from the small generator used in charging, a surprising thing happened: the generator ran as a motor in the same direction, instead of turning in the opposite way. The explanation of this peculiar behavior is that "the current from the batteries reversed the field of the generator, and also the armature, thus making two reverses, which is the same as none at all." What about the reversal of functions which takes place when changing a dynamo to a motor?

THE INFLUENCE OF ELECTRICAL ENGINEERING.

An interesting editorial in the *Engineering Magazine* for July dwells upon the necessity for the engineer to obtain a business training. He should appreciate the influence exerted by his work upon business methods, and he should therefore have a particular appreciation of his relation to the work of the world, so as to cause him to realize his position as an economist. To illustrate this relation the influence of electrical methods in various branches of work is cited: "It is a trite saying that railways have transformed commerce, but it is not so fully realized that with the improvement of communication in a thousand ways, by the telegraph, the telephone, the pneumatic tube and even the mail chute, business has been facilitated, effort concentrated and human energy conserved and directed."

The effect in manufacturing arts has been equally noteworthy: "In like manner, with the control and direction of human energy, the engineer is combining and controlling mechanical energy and directing natural forces. Already the development of the 'white coal' of Italy, Switzerland and France is diverting industries from centres originally created and still maintained by the diminishing supplies of fossil carbon. With the recognition of the fact that the true function of electricity is that of a transmitter of mechanical energy there has come an industrial development which is necessarily causing economic methods to be profoundly modified. The possession of local power facilities or of water transport no longer controls absolutely the situation of industrial establishments any more than the position of tools in the shop is determined by the position of the line shaft; the power is brought to the tool, and, in many cases, the tool to the work." It is this recognition of electricity as a means to an end, as the flexible agent for utilizing at one point power more conveniently generated at another, that has brought about such great changes in our industrial methods. Electricity is unquestionably the modernizing agent both in commercial and in manufacturing work.

DIRECTED WIRELESS TELEGRAPHY.

Some experiments made during the last year or so by Mr. William Marconi, on a method of directed wireless telegraphy, were described in the issue of the ELECTRICAL REVIEW for May 26. Results were given in this article both of laboratory tests and of tests carried out on a larger scale. The directive action was secured by means of a horizontal antenna stretched a short distance above the ground. Some encouraging figures were obtained, transmission in one direction being considerably better than in another. Polar diagrams, plotted from the laboratory experiments, showed that the curve of equal intensity took a double lobed shape, resembling somewhat two intersecting ellipses. No explanation was offered of the action of the transmitting system at that time.

In a note read a short while ago before the Royal Society, of London, Dr. J. A. Fleming, who has been associated with Mr. Marconi in his work in England for some years past, offers a theoretical explanation of the directive action of a horizontal antenna. Dr. Fleming considers this arrangement equivalent to three Hertzian oscillators placed at right angles to each other. The horizontal wire forms one, the connection between this and the ground and the ground itself the second, and that part of the ground lying below the horizontal wire the third. Dr. Fleming concludes from his analytical examination of this arrangement that its unsymmetrical radiation in the equatorial plane depends not upon the absolute wave-length, but upon the ratio of wave-length to the distance of the receiving point and upon the proportion between the length of the vertical and the horizontal portions of the oscillator; and these deductions seem to be supported by the observed facts. Mr. Marconi, in describing his experiments, said: "I have observed that in order that the effects should be well marked it is necessary that the length of the horizontal conductors should be great in proportion to their height above the ground, and that the wave-lengths employed should be considerable, a condition which makes it difficult to carry out such experiments within the walls of a laboratory." This is in accordance with Dr. Fleming's theory.

Another explanation of this action has been offered which also seems to fit the facts. This considers the horizontal antennæ as forming an electrical connection between two oscillating systems. One of these is the vertical connection between the horizontal wire and the ground, and the other is the oscillator formed by the extremity of the horizontal wire and the ground. These two oscillators, if placed a half wave-length apart, will oscillate with a difference of phase of 180 degrees, and hence the waves set up by one will be added to those starting from the other in the plane containing the two oscillators, and interference to a greater or less degree will take place throughout other angles. If the two oscillators were exactly equal and exactly a half wave-length apart there should be no transmission in the plane at right angles to the plane containing them. In other words, the horizontal conductor, according to this explanation, is merely a poor substitute for two properly tuned vertical antennæ placed the proper distance apart.

The curve showing the intensity of transmission of such a system, plotted on a polar diagram would resemble certain of the curves shown by Mr. Marconi. Moreover, since the length of the wave depends upon the height of the antennæ, the distance apart of the two vertical oscillating systems will depend upon their heights. It is possible that this arrangement will not explain all of the observed facts. The analytical study of these phenomena is exceedingly complex, so that in such a study it is generally necessary to assume rather ideal conditions, and then see how near one can come to them experimentally. These studies are nevertheless of great importance, since they guide the work of the experimenter, enabling him to proceed with a definite object in view, and not in a haphazard manner.

ENGINEERING EXPERIMENT STATIONS.

An interesting development now taking place in the central western states is the utilization of the university equipments for solving industrial and technical problems. Every one is familiar with the excellent work which has been done by the agricultural experiment stations in their particular field, but, until recently, the engineering schools made no attempt to assist the manufacturing industries in a similar way. Many—in fact, most—of these states have magnificent equipments for teaching various branches of engineering—equipments which consist not only of apparatus used in various branches of industrial life, such as boilers, engines, dynamos, machine tools, etc., but include as well accurate instruments for determining the performance of these machines, for carrying out all kinds of measurements and conducting investigations in any kind of work. The civil engineering department has, as a necessity, a complete collection of instruments, which no private engineer can aspire to, and the mechanical department has at its disposal not only many types of boilers and engines, but completely equipped shops. The electrical departments have instruments and supplies enabling them to make tests and conduct investigations in any line of electrical work. These equipments are needed to instruct the students in their use and to teach them the principles of engineering; but they are also available for carrying out such research work as the members of the teaching staff can undertake.

The new development contemplates putting these fine equipments at the service of the state for carrying out the investigation of problems which private companies or individuals can not undertake. In certain branches of industry the manufacturers have established research laboratories, where problems connected with the manufacture of their material, or which may possibly lead to the development of new apparatus and methods, are conducted. This is true notably in the electrical manufacturing business, but such laboratories are very few, and the results of their work are private, and not public, property. The work of the engineering experiment stations, on the other hand, will, in general, be made public, though they may, of course, undertake investigations for private concerns. In the first case the state gains directly, while in the latter it gains indirectly, since the state must benefit due to any improvement in any industry, and, further, since the fees required for conducting such an investigation will help to support the work of the station.

THE USE OF COLLOIDS IN TECHNICAL PROCESSES.

A new filament incandescent lamp, the invention of Dr. Hans Kuzel, of Baden, Austria, was described in the ELECTRICAL REVIEW for March 3. At the same time, reference was made to a patent obtained by the inventor covering the method of manufacturing this filament. The interesting feature of this patent—and, indeed, of the lamp itself—is the method of manufacturing, for it is applicable to a large number of materials difficult to work with in the ordinary way. The method, in short, consists in reducing the metal which is to form the filament to the colloidal state by volatilizing it under water by means of the electric arc. While in this finely divided condition it is mixed with a binder, the water evaporated so as to reduce the combination to the consistency of a paste, and in this form it is pressed through dies to form the raw filament. A slight drying of these filaments renders them conducting, so that the completion of the drying and conversion process may be carried out by an electric current passed through the filament itself.

This process is discussed at some length in *Engineering* (London) for July 6, and possibilities of a wider use of materials in the colloidal condition are suggested. In this condition the usual physical characteristics of the metal are held in abeyance. Hardness, brittleness or lack of ductility in no way interferes with the process, and, due to the exceedingly fine division of the metal, a mixture which is, to all practical purposes, perfectly uniform can be secured, so that with the driving off of the binding material a wire of uniform cross-section may be obtained.

As is well known, finely divided materials often exhibit powerful catalytic action. Sometimes violent chemical reaction may be produced if the materials are reduced to a fine powder, whereas, in the ordinary state, they would be inactive. It is thought, therefore, that metals in the colloidal state might be even more energetic and might bring about easily reactions hitherto unobtainable or brought about only with great difficulty. It has already been shown that colloids exert a great influence on fermentation and other organic processes, and it is very possible that certain of these uses may become important, as may also the reduction of materials to the colloidal state in working with them. The study of colloids has been taken up recently with renewed interest because of the electrical phenomena exhibited, and it will be strange indeed if no useful result comes about.

THE PRESENT CONDITION OF WIRELESS TELEGRAPHY.

There is no doubt that, for the present, at least, the most important use of wireless telegraphy is for transmitting messages across water. Whatever may be the future of the art, the need at present is for a reliable, powerful marine system. A good deal of interest therefore attaches to the present condition of wireless telegraphy when used at sea. For these reasons an article contributed to the proceedings of the United States Naval Institute by Commander B. T. Walling will be read with careful attention. Commander Walling has had a great deal of experience with the several systems now being tested by the Navy Department, and in this article he cites from tests made during the past two years.

The results, of course, varied with the apparatus and the power employed, and, no doubt, depended upon atmospheric conditions to a considerable extent. At times long distances were covered, messages being read, under favorable conditions, over distances of from 1,000 to 1,400 miles. During experiments conducted in January of the present year messages were received at Culebra Island, off Porto Rico, from the Atlantic fleet during several days. At times the sending vessel was over 1,100 miles distant. On one occasion the receiving station at Culebra was able to locate the relative positions of the different vessels of the fleet simply by the intensity and characteristics of the messages received. From these tests and others it is concluded that at the present time we have a transmitter sufficiently powerful for marine purposes; but as much can not be said respecting the receiver. Those employed on land are satisfactory, but those which may be used on a vessel can not be depended upon under all conditions.

Commander Walling says that this apparatus should be capable of transmitting messages 1,000 miles without overstrain, and 500 miles surely under favorable conditions—for example, at night. It should be able to send a message at least 300 miles at any time of the night or day.

An interesting phase of this problem comes up when wireless telegraphy is employed by naval vessels during times of war. The use of this method during the recent Russo-Japanese war is significant, and the author concludes that while it is possible for one fleet to confuse and render unintelligible the signals being sent out by the scouts which are watching it, and even to succeed in disabling part of the delicate apparatus on the scouts by keeping up a continual bombardment of intense electric waves, "the mission of the scout is to hang on and still hang on, and send, send, send, pushing his information into the atmosphere for a reasonable time with every watt of energy of which his transmitter is capable, and he will be successful!"

ELECTRIC RAILWAY DEVELOPMENT AT NIAGARA FALLS.

It is interesting to follow the drift of opinion among steam railroad men respecting electrification. A few years ago they did not hesitate to say that the electric motor was incapable of taking up the work of the steam locomotive. A little later they admitted that the motor could do the work, but said that it would be more expensive to operate than the steam locomotive, and would only be used where the steam locomotive is displaced for special reasons. To-day we find a good many railway engineers who are taking a still more favorable attitude.

The point of view taken by some is well shown by the remark made by a widely known engineer who was at Atlantic City. He said that, in his belief, the day was not distant when every locomotive between Syracuse and Cleveland, and in all that territory not more than 100 miles from Niagara falls, would be operated from power generated there. Such a transformation would be of enormous industrial importance, but it is to be hoped that in bringing it about the æsthetic value of Niagara will not be lost sight of.

The Sixth Annual Convention of the National Electrical Contractors' Association.

Cleveland, Ohio, July 18, 19, 20.

As published in the ELECTRICAL REVIEW last week, a large and representative body of men gathered for the sixth annual convention of the National Electrical Contractors' Association, held at Cleveland, Ohio, on July 18, 19 and 20. Nearly 600 names were registered on the association books. Delegations came from nearly all the large cities, and New York, Chicago, Boston, Philadelphia and Cincinnati were especially well represented.

The two sessions held on the mornings of Wednesday and Thursday were attended by many of those whose interests brought them in contact with the work of the contractors, though they were not all eligible to membership. The other several meetings were behind closed doors and were devoted to deliberations on the questions of labor unions and the conditions arising with employés, the work of the local and national boards of inspection, the use of special types of fittings and equipments, etc., etc.

In the last issue of the ELECTRICAL REVIEW a report of the first day's proceedings was given. The meeting of the 19th was partially devoted to an address by J. Robert Crouse, who described the purposes and accomplishments up to this time of the Cooperative Electrical Development Association, and especially the bearing of the work of the association on the welfare and progress of the electrical contractors. Mr. Crouse has such a mastery of the subject and has analyzed each situation so carefully that his point of view of the spirit and progress of cooperation as it applies to the progress of the electrical contractors was especially timely and interesting.

During this meeting an address was made by J. H. Montgomery, of the National Electrical Inspectors' Association, and his remarks covered some of the phases of electrical inspection arising from the constantly changing conditions developing in all construction work.

National Treasurer J. R. Galloway, of Washington, D. C., was the last speaker at this meeting.

On the afternoon and evening of the 18th and the afternoon of the 19th, long and animated business sessions of the association were held, which were attended only by accredited association members, and of these meetings the ELECTRICAL REVIEW offers no report, in deference to the wishes of the association.

At seven o'clock on the evening of the 19th a dinner was served in the Hollenden banquet room which was exclusively for members of the National Electrical Contractors' Association. No facilities were granted to press representatives for reporting the speeches and toasts during the affair. John P. Coghlin, of Worcester, Mass., acted as toastmaster, and responses were made by Jas. R. Strong, president of the association; E. M. Lawton, of Cincinnati, state director for Ohio; D. N. Goble, of Dallas, Tex., and John P. Faure, of Ossining, N. Y.

As the result of actions taken at the final business session Thursday afternoon, President Strong was authorized to appoint a committee to cooperate with the Winona trade school at Indianapolis, Ind. This school is doing much for the education of boys in mechanical arts, and the naming of a committee was requested, so that the association might officially acknowledge the good work done by this school.

Another important committee appointed was one to consider the pros and cons as to the use of uniform specifications and contracts for such work as is generally done by electrical contractors, and a report of the conclusions of this committee is to be submitted to the association at the next annual meeting.

An action which will be of wide interest was the adoption by the association of a series of official symbols to be uniformly used in making electrical wiring plans and construction work, and a committee was appointed to place the plan for the use of these symbols before the architects and engineers of the country and to endeavor to accomplish their cooperation toward their adoption.

At this last business session the following officers were elected: James R. Strong, New York, president; W. T. Gray, Minneapolis, first vice-president; Walter C. McIntire, Philadelphia, second vice-president; F. E. Newbery, St. Louis, third vice-president; J. R. Galloway, Washington, treasurer; W. H. Morton, Utica, N. Y., secretary; J. C. Sterns, Buffalo, sergeant-at-arms.

On Friday, the 20th, all the members of the association, with their guests, to the number of 500, went by steamer to Put-in-Bay as the guests of the Ohio State Association. Dinner was served en route, and the boat reached Cleveland on the return trip during the early evening. Many ladies were in the party and the day was the social event of the week. Among the other social features on Tuesday, the 17th, a luncheon was served at the Hollenden Hotel for the officers of the National Association by officers of the Ohio State Association.

A reception for ladies by the ladies' entertainment committee was held on Tuesday and a ladies' luncheon was served at 1 P. M. During the afternoon a trolley ride was given for the ladies.

On the following days numerous entertainments were so arranged that the ladies and guests were furnished with enjoyable amusements.

The next annual meeting of the association will be held in New York city for three days, beginning the third Wednesday in July.

A number of manufacturing companies exhibited and among those present the following may be mentioned:

Buckeye Electric Company, Cleveland—represented by L. P. Sawyer, Milton Hartman, F. W. Bliss and W. Ennis.

Brilliant Electric Company, Cleveland—E. J. Kulas and R. S. Jackson.

A. & W. Electric Sign Company, Cleveland—F. E. Hays, general sales agent.

Reynolds-Dull Flasher Company, Chicago—E. R. Dull, president.

W. J. Barr Electric Manufacturing Company, Cleveland—W. J. Barr and Thomas E. Barr.

Pass & Seymour, Incorporated, Syracuse, N. Y.—J. W. Brooks, F. F. Skeel, A. M. Little and W. Brewster Hall.

Wagner Electric Manufacturing Company, St. Louis, Mo.—Thomas T. Richards.

F. D. Lawrence Electric Company, Cincinnati, Ohio—represented by Charles S. Nolloth.

Vallee Brothers Electrical Company, Philadelphia, Pa.—Dale B. Scarborough, sales manager.

American Circular Loom Company, Chelsea, Mass.—H. B. Kirkland, Alex Henderson, Thomas G. Grier and H. C. Adams, Jr. This company distributed an artistic little memorandum book.

V. C. Gilpin, manufacturers' agent, New York.

I. A. Bennett, manufacturers' agent, Chicago.

Francis Raymond, manufacturers' agent, Chicago.

Alpha H. Kling, manufacturers' agent, Peru, Ind.

Barriett Electric Manufacturing Company, Cincinnati—represented by C. H. Haddrell, president.

Mark Manufacturing Company, Chicago—E. L. Markle.

Benjamin Electric Manufacturing Company, Chicago—O. Bennett.

John A. Roebling's Sons Company, Trenton, N. J.—F. W. Harrington and J. B. Bowman.

Union Electric Company, Pittsburg, Pa.—Percy Frost and L. H. Kellar.

American Watchman's Time Detector Company, Cleveland, Ohio—J. E. Kellar.

Steel City Electric Company, Pittsburg, Pa.—J. N. G. Fullman.

Osburn Flexible Conduit Company, New York, N. Y.—C. E. Corrigan.

Economy Manufacturing Company, Economy, Pa.—R. L. J. Fortune and C. E. Corrigan.

Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.—C. O. Baker, Bailey Whipple and others.

Troy Electric Company, Troy, N. Y.—E. G. Bernard.

Doubleday-Hill Electric Company, Pittsburg—Elliott Reynolds, manager Columbus, Ohio, office.

Trumbull Electric Manufacturing Company, Plainville, Ct.—F. Trumbull.

George Worthington Company, Cleveland—David Aikin.

India Rubber and Gutta Percha Insulating Company, New York, N. Y.—J. B. Olson, sales manager.

Dossert & Company, New York, N. Y.—E. A. Dossert.

W. R. Ostrander & Company, New York—H. E. Monk.

Columbia Incandescent Lamp Company, St. Louis, Mo.—Coles King.

Novelty Incandescent Lamp Company, St. Marys, Pa.—M. K. Mickey, president.

Banner Electric Company, Youngstown, Ohio—N. C. Norris.

Standard Electric Manufacturing Company, Niles, Ohio—H. H. Albert and L. J. Crane.

American Conduit Manufacturing Company, Pittsburg—C. A. Flack.

Phelps Company, Detroit, Mich.—W. C. Phelps.

Hart & Hegeman Manufacturing Company, Hartford, Ct.—George S. Searing, manager Chicago office.

Crouse-Hinds Electric Company, Syracuse, N. Y.—C. M. Crofoot.

W. P. Crockett, manufacturers' agent, Chicago.

De Veau Telephone Manufacturing Company, New York, N. Y.—Charles Auth.

J. Lang Electric Company, Chicago—Warren Ripple.

Western Electric Company, New York and Chicago—E. M. Rockafellow, F. Dusenberry, S. Baldwin and others.

Gail-Webb Manufacturing Company, Buffalo, N. Y.—H. M. Gail and Charles W. Webb.

Switchboard Equipment Company, Bethlehem, Pa.—G. L. Crosby.

S. B. Condit Electric Manufacturing Company, Boston, Mass.—S. B. Condit, Jr.

Electric Storage Battery Company, Philadelphia, Pa.—W. W. Winship.

Eastern Carbon Works, Jersey City, N. J.—O. L. Turgeon.

M. B. Austin Company, Chicago—M. B. Austin.

Sarco Company, New York—Ralph A. Schoenberg.

Warren Electric and Specialty Company, Warren, Ohio—Colonel E. E. Nash.

The F. Bissell Company, Toledo, Ohio—W. S. Bissell.

Jandus Electric Company, Cleveland—J. Potter.

D. & W. Fuse Company, Providence, R. I.—represented by the sales department of the Western Electric Company.

Hart Manufacturing Company, Hartford, Ct.—W. P. Crockett, manager Chicago office.

F. D. Killion, of the Western Electric Company, Chicago and New York—representing D. & W. specialties, and "Deltabeston" wire.

The Twelfth Annual Convention of the Ohio Electric Light Association.

The twelfth annual convention of the Ohio Electric Light Association will be held at Hotel Victory, Put-in-Bay Island, Ohio, Tuesday, Wednesday and Thursday, August 21, 22 and 23. The papers already prepared and the arrangements which have been made ensure a very instructive and interesting convention. A few of the subjects upon which papers will be presented are as follows: "Natural Gas Engines in Competition with Electric Motors"; "What Inducement Should Be Given to Increase Business in Villages or Small Cities in Which the Population is Not Increasing?" "Description of Wiring of a Moderate-Priced Residence Scientifically Lighted"; "Progress of High-Efficiency Lighting Units in Ohio by Central Station Men"; "New Business—How to Get It and How to Keep It"; "One Successful Way to Get Business"; "Legislation—Its Uses and Abuses"; "Luminous Arc Lamps with Mercury Arc Rectifiers"; "Notes on High-Efficiency Lighting Units by the Manufacturers, and Wiring for Electrical Appliances Other Than for Lighting."

There will be reports of the committee on cost determination and the committee on publicity, and an illustrated lecture on electric heating and cooking devices.

The entertainment features will be made particularly attractive to ladies. A number of prizes have been provided, and a series of games and contests has been arranged so that every lady will be able to take part. The games consist of a card party, bowling contest, guessing contest, tennis or croquet, and an aquatic contest in the natatorium. In addition there will be bathing, automobile rides and other special features for both the ladies and gentlemen. The Sons of Jove will hold a rejuvenation on Wednesday evening, August 22.

The secretary of the association is D. L. Gaskill, Greenville, Ohio.

Alcohol Engine Investigations.

As a result of the passage of the bill allowing the sale of alcohol without the internal revenue tax, the Department of Agriculture has decided to publish a bulletin on January 1, 1907, when the law goes into effect, giving the public a collection of the best obtainable data on the use of alcohol in small engines. For this purpose Professor Charles E. Lucke has been retained by the department as expert to conduct these investigations at the laboratories of Columbia University, New York city. This bulletin will contain all of the work done on the subject here and abroad, a complete bibliography, together with the results of experiments and conclusions drawn therefrom on American engines.

Professor Lucke is desirous of securing the cooperation of everybody interested in this matter and invites the contribution of any data or suggestions concerning the existence of such data. Any patents relative to this subject on vaporizers, carbureters or complete engines will be investigated and apparatus tested in the laboratory. These tests will be conducted without expense to the public, except the transportation of the apparatus. The reports will be published in the bulletin. Data or shipments should be addressed to Professor Lucke at Columbia University, and they will be returned when the work is completed, due acknowledgment being given for the assistance rendered.

Change of Name of the National-Interstate Telephone Association.

In accordance with the change made in the constitution, the name of the National-Interstate Telephone Association is changed to the International Independent Telephone Association of America. For convenience in general correspondence, the last two words in the title will be omitted.

Chicago, Lake Shore & South Bend Railway.

J. G. White & Company have completed estimates and surveys for an important addition to the traction system centering in Chicago, which will be an electric railroad seventy miles long from South Bend, Ind., to the Illinois-Indiana state line in the city of Hammond, to be known as the Chicago, Lake Shore & South Bend Railway. It is reported that the road will be financed by the Transit Finance Company, of New York, and it is expected that the line will be completed by the Illinois Central from Hammond northwest into Kensington, there making connection with the Central tracks for a continuous route into Chicago. The Illinois Central is bound by traffic agreements not to build east of the state line, which accounts for the rather unusual construction conditions.

From Hammond the new road will run eastward into the United States Steel Corporation, city of Gary, crossing the Grand Calumet river just before entering the city. From Gary east to Dunne Park the electric line will practically parallel the tracks of the Lake Shore & Michigan Southern, crossing them as well as the tracks of the Baltimore & Ohio Railroad from the south to north at Miller. From Dunne Park to Michigan City the route of the electric road will lie between the tracks of the Michigan Central and the shore of lake Michigan. The route from Michigan City is almost straight east to South Bend, a distance of about thirty miles. The tracks of the Lake Erie & Western Railroad and of the Pere Marquette will be crossed about a mile east of Michigan City. From New Carlisle into South Bend the electric road will be exactly parallel to the Lake Shore & Michigan Southern for a distance of fourteen miles. It is anticipated that a steamer service from Michigan City to Chicago will be run in connection with the new road, giving the residents in the district from Michigan City to South Bend, inclusive, a particularly quick and convenient route into Chicago. The road will be for both passenger and freight traffic, and that it will be thrown into direct competition with the steam roads in the district is at once apparent. Indeed the situation now obtaining on the south shore of lake Erie between Cleveland and Toledo will be practically duplicated on the completion of the new road. It is not as yet determined whether the line will be single or double track.

The construction will conform to the best interurban standard, and track will be laid with seventy-five-pound rails. The specifications in the case of the single-track line call for a width of eighteen feet on the fills and twenty-one feet in cuts, with side slopes one and one-half to one. All bridge structures, except the bridge over the Calumet river, will be of concrete or steel, and two trolley wires will be included in the overhead equipment. In case the single-track road is decided upon, eight sidings, each 2,700 feet long, will be provided. Specifications for double-track road provide for a width of thirty-one feet on the fills and thirty-four feet in cuts. The conditions of grade and curvature will be very moderate over the entire line. On eighty-five per cent of the road the grade will not exceed two-tenths of one per cent, and the usual maximum for overhead crossings will be two per cent. At two points, however, the grade on these bridges may run to five per cent. As approved, the total curvature for the line amounts to 1,034 degrees, divided between fifty-nine curves, practically all within the city limits of the various towns *en route*.

Increase in Power Plant of the Pittsburg Railways Company.

Almost 30,000 additional horse-power in boilers, engines and electrical machinery will be added to the great Brunot's Island power-house of the Pittsburg Railways Company this year. Contracts were closed this week and involve considerably over $300,000 in investment.

There lately have been tremendous demands for power upon this plant, because of the extension of lines in all directions not only in the two cities, but throughout the suburban districts. The company, when it built the big plant on Brunot's Island, arranged for increasing the plant to 50,000 horse-power. With this additional power the plant will contain practically this limit and there is a likelihood that it will be further increased in the future.

New equipment contracted for consists of three turbine engines of 7,500 horse-power each and one of 5,000 horse-power, making a total of 27,500 horse-power. Besides this, there will be the additional boiler capacity, electric generators, switchboards and wiring.

Initial installation of turbine engines by this company makes it one of the most important orders in the country. Pittsburg is at present the slowest to take hold of the new power method, and this installation is the first of importance in the city. The Westinghouse Electric and Manufacturing Company and the Westinghouse Machine Company have the orders for the entire contract.

The additional power will not only be used for the new traction lines to be ready for operation soon, but for lighting purposes as well. The company has started a regular schedule on its new line from Avalon to Emsworth, that line having recently been completed. Work is now to be started on the next division of the road down the Ohio river toward Beaver, which will run from Emsworth to Dixmont, passing around the rear of Sewickley, and when that line is completed the distance between Pittsburg and Beaver will be nearly closed up with electric roads. These will be supplied with power from the central power station in Pittsburg.

The new suburban line from Pittsburg to Canonsburg and then to Washington, Pa., will be completed this year and will demand more power, while the expansion of the city lines in many directions all call for additional power. In these additions the plan is to transmit the power over high-tension wires from the power-house to distributing points, where it will be reduced in voltage to the requirements of the service. The power will go out of the power station in the form of an alternating current and be transformed to a low voltage direct current for car service.

When the Brunot's Island power-house is fully equipped it will be one of the largest of its kind in the world. There are some larger plants in hydraulic power in this and other countries, but when steam is depended upon the matter is different. The first power-house of the Niagara Falls Power Company, with its great hydraulic turbines, contains only 50,000-horse-power capacity, and when built was the largest unit of horse-power known. Under the old forms of steam power such a unit would have been almost impractical.

Fuel for this plant will come almost exclusively from a coal mine owned by the Pittsburg Railways Company adjacent to Brunot's Island, and which will give the company plenty of coal at practically the cost of mining. The fuel arrangements give the company quick handling of coal, and the ashes from the boiler are being used to fill up the low parts of the island, thus reclaiming them for commercial purposes. The total cost of the plant will be close to $2,000,000.

The exports of copper for the first six months of 1906 were 101,765 tons, against 129,801 tons for the first half of 1905. The imports for the first six months of 1906 were 50,205 tons, against 44,100 tons for the same period in 1905.—*Copper Gossip.*

The New St. Denis Electric Plant at Paris.

By C. L. Durand.

THE city of Paris now possesses a number of electric stations which have been laid out on a large scale, but none of these has a greater interest than the new plant which is in erection at St. Denis, and which is now partly completed. When entirely finished, the station will be far the largest which is to be found in the region, and there is probably no other plant which will surpass it in the size of the buildings and the capacity of the units. The St. Denis plant is noteworthy for several reasons: first, on account of the vast size of the plant, the number of buildings and the extent of ground it covers, from the fact that reciprocating engines are entirely dispensed with, and it uses steam turbine and dynamo groups of the largest capacity which have yet been built on the Continent. Another feature which impresses the observer is the modern design of the whole station, especially as regards the use of automatic appliances for carrying out most of the operations such as handling the coal, boiler stoking, switchboard connections, pumping plant and many others, so that one is surprised to see the small amount of labor which is employed to handle such a large station.

Owing to the constantly increasing amount of current which is used in Paris and the suburbs for the lighting mains, the tramways and stationary motors, the new plant will find a ready use for all the current which it is capable of furnishing. The Metropolitan subway comes in for a large share of this current, and its lines are laid out to receive high-tension three-phase current at twenty-five cycles, this being connected in the different substations in the city. But the St. Denis plant will also be called upon to furnish a supply for a number of the city mains, notably for two systems of mains which are under the control of separate companies, each operating its own generating station. The circuits are laid out to run upon two-phase current at forty-two cycles, and in order not to be obliged to increase their stations, they will no doubt use a considerable amount of current from the St. Denis plant. Direct current is also to be furnished by the station for a number of tramway lines, especially those which lie in the neighborhood of the plant, and for this it is necessary to operate generating units at 550 volts. For the use of the station itself, notably for the large number of motors which are used in the premises as well as for the lighting, it was decided to use direct current at 250 volts.

While it would have been preferable to have laid out the station so that the main units should be all alike, it will be seen that under the existing conditions this could not be carried out, and accordingly it was decided to employ different units which should furnish three-phase current at 10,250 volts and twenty-five cycles as well as two-phase current at forty-two cycles, also direct current at 500 and at 250 volts. We shall see in the following description how these different kinds of current are provided for. It is to be remarked that at present the four main turbo-generator groups which have been installed are all designed for twenty-five-cycle current, and it is proposed to erect other sets for the forty-two-cycle current during the year. The steam turbine units and most of the electrical outfit in general has been furnished by the well-known Swiss firm, Brown, Boveri & Company. The writer is indebted to Mr. Durand, one of the chief engineers of the St. Denis station, for most of the information which is here given.

One of the engravings (Fig. 1) gives an idea of the general appearance of the St. Denis plant when viewed from the Seine, but as this is an end view of the buildings the general disposition is better seen in the plan view (Fig. 2). In laying out the station with a view of extending it greatly in the future, it was decided to build it in a certain number of units, each boiler house, coal bins and the corresponding machines in the dynamo room forming one such unit. Referring to the plan view A is the dynamo building which contains the main turbine groups. At B are the three boiler houses and back of each of them are four smokestacks. The three coal bins at C have almost the same size as the boiler rooms. The disposition of the units, which are formed in this way, is observed in the general view, and one such unit is now completed. Before the end of the present year it is expected to have all the part of the plant erected which is shown in the plan view, with the exception of the portions indicated in dotted lines, and the work upon the new portion is now being actively carried on.

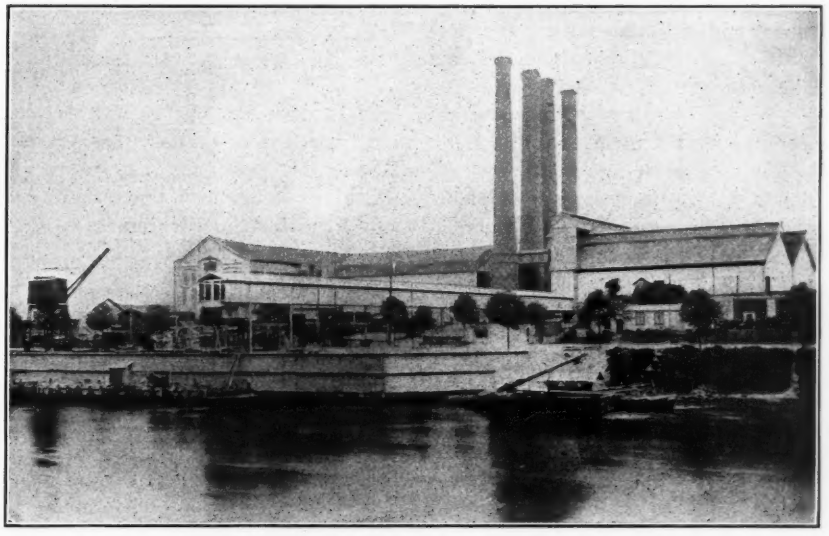


FIG. 1.—VIEW FROM THE SEINE OF THE ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The interior of the large building, which contains the coal bins, four in number, is shown in Fig. 3. Each of the bins has sufficient capacity for storing over 4,000 tons of coal, making 16,000 tons for the whole building. The latter is a square structure of brick, stone and iron beams, and measures about 140 feet on a side. Coal is brought into the building from the Seine by a well-planned system of motor-driven conveyers. The boiler room has about the same dimensions as the former building, and is designed to contain twenty Babcock & Wilcox boilers, with super-

heaters and all the accessory parts, using automatic stokers for the furnaces.

The main building, which contains the machines, is a large brick and iron structure which has sixty-five feet width and a height from the ground level of fifty feet. When completed as far as is shown here, this building will be about 600 feet long. Below the ground there is an elaborate system of foundations, which go down to a first level or basement at sixteen feet depth, then to a second level at fourteen feet below this point. In this building are contained two ranges of main steam turbine units, which have a capacity of 12,000 horse-power each, and are constructed by the Brown-Boveri firm, of Baden, Switzerland. An iron staircase leads down to the basement, and in this part is a chamber containing the motor-driven pumps for the condensers. At present two rotary converters have been installed, and a booster set for the storage battery. There is also a smaller steam turbine unit, which has a capacity of 300 kilowatts and operates a direct-current generator. Of the main turbine groups, four complete units have now been installed, and two of these are now supplying current. Against the dynamo building is an annex of four stories and a basement, which is designed to contain the various circuits of the switchboard. The operating tables of the board are located in the upper story of this building. A general view of the generating room is shown in Fig. 4.

The coal is brought alongside the station on barges, and an electric crane, mounted on the wharf, lifts the coal from the barge and drops it into a hopper, from which it falls in an even distribution upon a horizontal conveyer of the continuous pattern. At the end of its course this conveyer, which has a capacity of eighty tons per hour, pours the coal into a hopper and thence it is taken by a vertical bucket conveyer. Later on it is designed to add a second electric crane and a second conveyer so as to make the system double, and working on either side of the last-mentioned hopper. The vertical conveyer takes the coal up to the buckets of the principal conveyer which passes from the Seine along a covered passageway into the coal building. Another set of buckets receives the coal and raises it to the height of the roof, at which point a horizontal conveyer receives it and runs along under the roof so as to drop the coal into the bins. This latter conveyer is double, and there is one for each half of the building. The coal is weighed and registered by automatic scales along its passages.

No less interesting are the methods which are used for taking the coal from the bins into the boiler room. The conveyer after passing across the roof of the building and pouring out the coal is brought down the side wall of the building, passes into a sheet-iron protecting housing, and then runs along in a gallery which lies underneath the coal bins and parallel with the portion on the roof. As this tunnel is provided with a set of chutes leading from the bins, the coal can be dropped into the conveyer buckets by operating a set of gates. Thence the conveyer mounts up the opposite wall and after passing the coal through a weighing device it is transferred to the horizontal conveyer which runs along over the boiler room. The interior view of the boiler room (Fig. 5) shows the under side of the coal bunkers for the furnaces, and the last-mentioned conveyer is made to discharge into these bunkers as it passes along above them.

After passing over the coal bunkers, the conveyer descends along the opposite end of the boiler room and runs along under the floor in a large tunnel. The buckets which are now empty are utilized to take off the cinders from the furnaces, but the latter are not discharged automatically into the conveyer from the ash-pits, seeing that the heat of the cinders might damage the apparatus, so that the cinders are cooled first by a water spray and then are loaded upon the buckets by hand. The conveyer then passes out and reaches the pits, which are designed to contain the cinders, these being located in the front part of the coal building, and after rising along the wall the conveyer pours out the cinders, which are thus

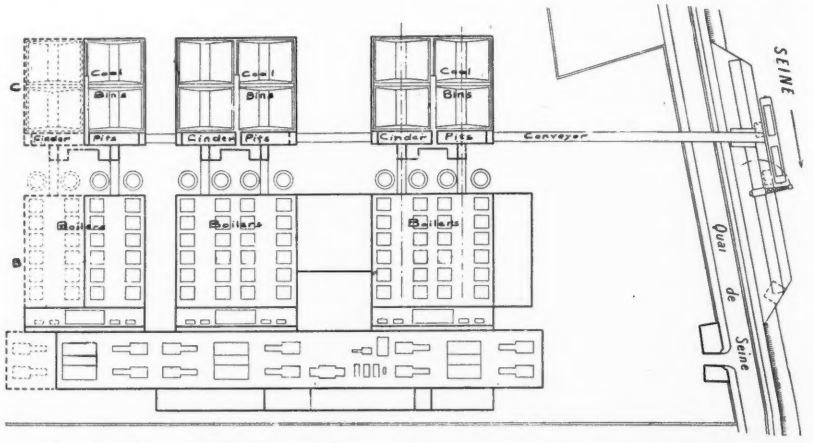


FIG. 2.—PLAN OF ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

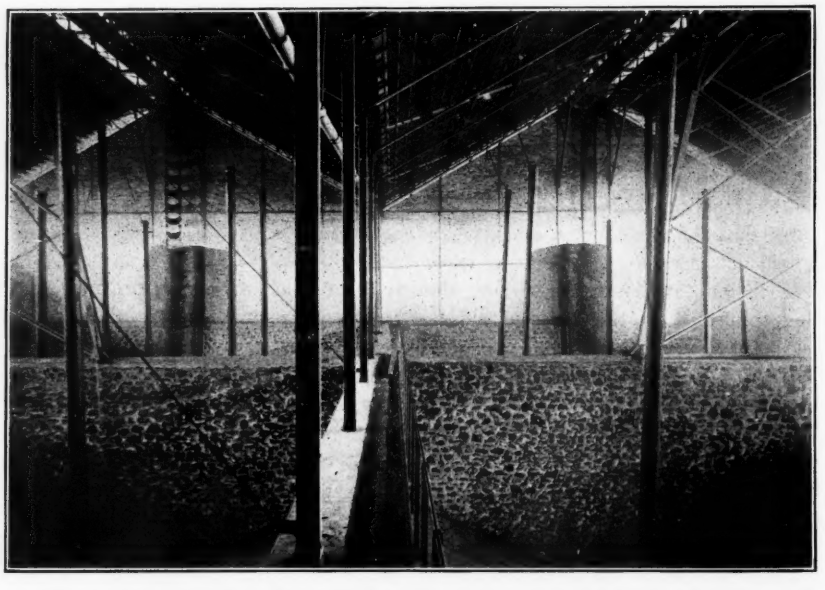


FIG. 3.—COAL STORAGE BINS, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

stored up and may be taken out of the building on carts, or when the main conveyer is not in use they can be taken upon it directly to the Seine by reversing its movement, and so can be loaded upon the barges.

There are four ranges of boilers with five units in each row. The furnaces of two ranges face toward each other, leaving a middle space between the boilers, as will be noticed in the interior view (Fig. 5). A complete system of automatic stoking has been adopted in the present case. From the coal bunkers the coal descends through a hopper and falls into a feeding hopper which is placed above the furnace. The grate of the furnace is formed of an endless platform, which is made up of heavy iron links articulated so that the system is passed over two drums at the front and rear of the furnace. Revolving the drums causes the web to move slowly to the inside, and it draws along the coal, which is fed down on it from a narrow slit. A countershaft passing along above the furnaces works a series of vertical shafts, which control the rotation of each drum. The coal feed is varied by a gate which works in the feeding trap. Each group of five boilers corresponds to one of the smokestacks which are between the boiler room and the coal building. In order to secure a good regulation of the draught in the flues which lead from the boiler furnaces to the chimneys, in each of the flues is placed a swinging gate which opens or closes the orifice. These gates are operated electrically from a special switchboard panel located in the adjoining room. On the panel is mounted a gauge whose indications are transmitted electrically from a thermometer which is located in the flue, so that the attendant can see the temperature of the outgoing gases and regulate the draught accordingly.

The steam which leaves the boiler is taken off by four main pipes which pass along the boiler room, and these join on to a main collecting pipe which lies in the middle space. From the latter are branched five separate sets of piping and these pass into the dynamo room to the steam turbines, using four sets of large capacity for the four principal turbines, and one set of smaller piping for the 300-kilowatt group. In the case of the steam piping, which leads to the main turbines, it has been given a uniform section of twelve inches, which was the largest section allowable in the present conditions on account of the distance.

In the space between the boiler room and the dynamo hall are placed the main pumps which are used for the boiler feed. These are located in the basement, while the ground floor is devoted mainly to the different kinds of indicating and controlling instruments and panels. Here are also placed a set of water meters, as well as the storage tanks for the main water supply. Only a small part of the water for the boilers is taken direct from the Seine, seeing that the condensers are made to furnish most of the water. The latter is used directly, while the additional amount of river water is passed through a filtering apparatus. Four main tanks, two in the basement and two in the upper part of the building, are used to contain the main supply of pure water for the boiler feed. Each of these tanks has a capacity of 150 cubic yards.

At present there are three water pumps

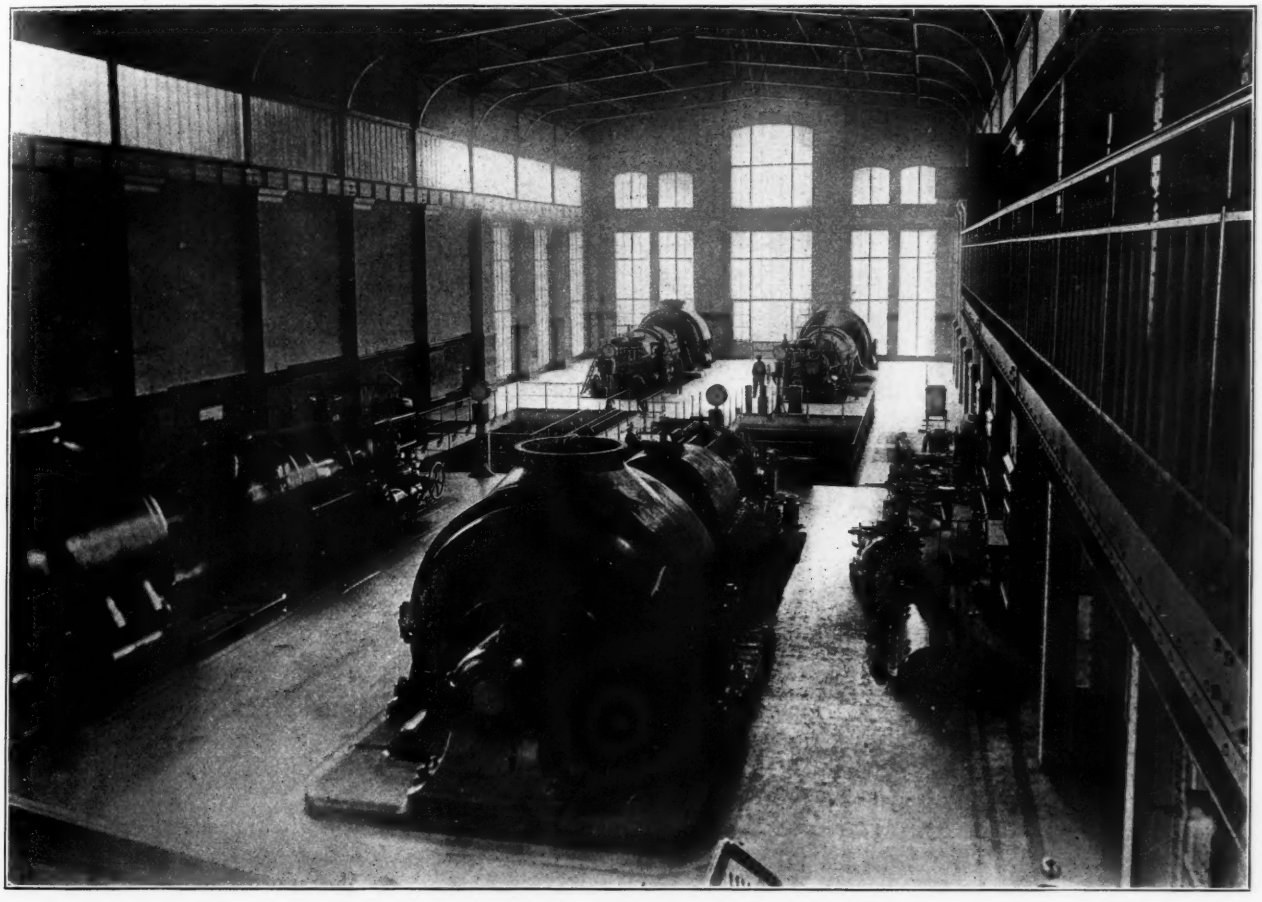


FIG. 4.—GENERATOR ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

in operation for the boiler feed. One of these is a Laval turbine-pump, driven by a direct-current motor of eighty horse-power working at 1,200 revolutions per minute. The second pump is of the triplex pattern with four vertical pistons and is also operated by an electric motor. Another pump of this kind is soon to be installed here. A steam pump of the Weir pattern completes the present outfit.

The building which has been erected to contain the main turbine-dynamo groups of the station, together with the condensers, pumps and other apparatus for handling the water supply of the condensers is shown in section in Fig. 6. The upper story of the building is used to form the main hall and is laid out to contain the principal generating groups and smaller turbine sets, together with the rotary converters, boosters and other apparatus, besides a special converting group which we will mention below, also the minor switchboards for these different machines.

FIG. 5.—BOILER ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

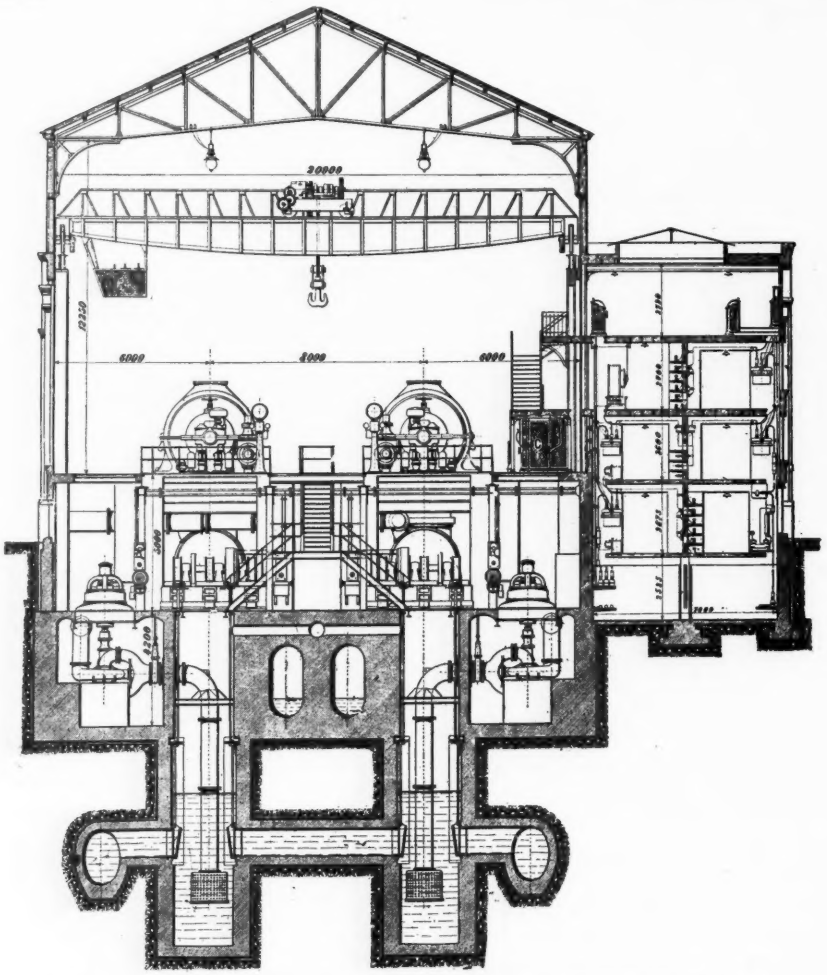


FIG. 6.—SECTIONAL VIEW OF THE ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

Underneath the main floor is a basement in which are placed the motor-driven pumps and various appliances which are needed for the water supply. In order to obtain the water supply, two long water flumes run from a point which is well below the ground level and lead to the Seine; at the mouth the flumes are provided with a special inlet arrangement, and the water is sent into a series of deep wells, connected across by a gallery. The water inlets and also the latter gallery are controlled by a set of gates which are operated by a rod transmission running to the main basement floor. Four wells are grouped together at one point. By connecting the wells in pairs, one pair can be used at a time, and is supplied from one of the main water flumes, should it be necessary to make repairs upon the other flume.

On the level of the basement floor is mounted a turbine pump which takes the water up from the well by means of the piping and sends it to the condensers. Each of the wells has one independent motor-driven pumping set of this kind. The motor is mounted on the top of the pump upon the vertical shaft. This motor is of the eight-pole, 130-horse-power Brown-Boveri type, and runs on 220 volts, direct current, using a maximum of 470 amperes, and running at 310 revolutions per minute. Each of the four motors is provided with a small marble panel containing a 500-ampere ammeter and a carbon-break switch. An oil rheostat for the motor is placed on the floor. Flush with the cement floor of the basement are the circular iron traps which cover the mouths of the wells. The pumps send the water into the condensers, and thence it descends into the evacuation conduits which lie close together under the middle of the basement. These conduits are

placed at a higher level than the inlet flumes, and run from the station to the Seine, where the water is discharged.

Symmetrically disposed to the four turbine pumps are four motor-driven pumps which serve as air-pumps for the condensers. These latter groups work with horizontal shaft and the latter operates three pump cylinders of large capacity. Between two of the cylinders is mounted a Brown-Boveri ten-pole direct-current motor of fifty horse-power, which operates on 220 volts, 195 amperes and 225 revolutions per minute. The air is sent through piping to the condensers, which are placed in galleries in the rear of the pumps.

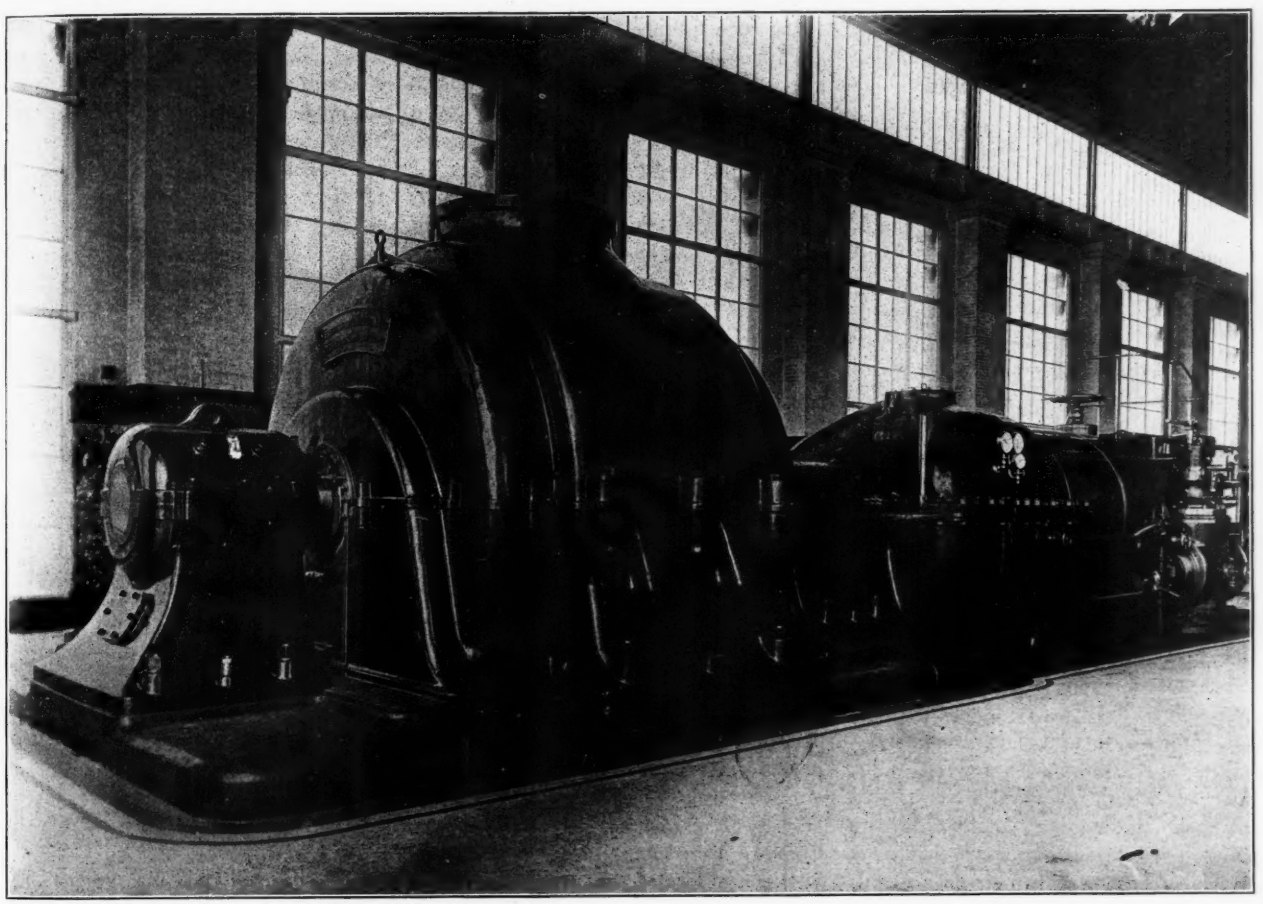


FIG. 7.—NEAR VIEW OF 12,000-HORSE-POWER TURBO-ALTERNATOR, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

One of the main points of interest in the station is, of course, the steam turbines, which are among the largest of the kind to be built. No less than 12,000 horse-power is given by each of the four turbines, and taken together they have a total capacity of nearly 50,000 horse-power. Allowing for the twelve turbine groups which it is expected to erect, a final capacity of about 150,000 horse-power will be available. Fig. 7 is a near view of one of the 12,000 horse-power units. On the front end is mounted the governor. The main operating hand-wheel for the inlet is placed in front of the turbine. A heavy foundation plate is used to support both turbine and alternator, and it rests upon a concrete foundation which goes down to a considerable depth. As is the usual practice for steam turbines, the foundation plate rests upon the concrete mass without the use of bolts. Since the two groups which are now running in the station have been in operation, no trouble has been experienced, and everything seems to have gone on smoothly from the start. The alternator which is mounted on the end of the turbine shaft is entirely enclosed in a casing, part of which is formed by the field casting of the machine and the remainder by two end-plates which have no openings in them, so that the whole group of turbine and alternator is entirely ironclad. A cap-plate can be unbolted from the top of the alternator to allow of inspecting the inside. The alternator is a three-phase machine which is built to deliver 5,000 kilowatts when on normal running, but has sufficient capacity to be run as high as 6,000 kilowatts without undue overheating. The speed of operating is 750 revolutions per minute. A standard voltage of 10,250 volts has been adopted as the best for working the alternator at this speed, with a frequency of twenty-five cycles. That the present groups have a very reasonable size for their capacity will be observed from their general dimensions, which are: length, forty-seven feet; width, fourteen feet; height, eleven feet. When running on no load, the turbines consume about fifteen pounds of steam per kilowatt-hour and on half load this rises to eighteen pounds, using superheated steam at 300 degrees centigrade and a pressure of twelve atmospheres.

Besides the principal turbine groups of the station, a smaller steam-turbine set has been erected, which has a capacity of 300 kilowatts. In this case there is a direct-current generator coupled on the shaft. The general appearance of this group is about the same as that of the large groups. The direct-current machine operates at 2,700 revolutions per minute, and it delivers 230 volts and 1,360 amperes. Means had to be provided for ex-

citing the fields of the main alternators while the turbines were being started up. The present group accomplishes this and furnishes the needed current, then when the alternators are running at full speed the three-phase current is used to operate the rotary-converter groups of the station, and the latter supply the exciting current for the alternators when the small turbine group is stopped. A small exciter is mounted on the outside of the main direct-current machine of this group, seeing that its field is separately excited. On the side of the foundation plate is fixed a rheostat with hand-wheel which controls the exciter, so that the group is quite independent. Owing to the high speed at which the turbine is run, the commutator of the dynamo is braced in the middle by a heavy steel ring, which is shrunk on to it in order to prevent bursting.

Not far from the last-mentioned group are the sets of rotary converters. These machines consist of a Brown-Boveri direct-current generator mounted on the same bed-plate with a three-phase motor. Working at the standard speed of 375 revolutions per minute, the three-phase machine acts as a motor and runs on the main-station current of 10,250 volts and twenty-five cycles, using some twenty-five amperes at full load. It thus operates the direct-current generator so as to furnish all the continuous current which is needed for the general use of the plant, such as for exciting the alternator fields, lighting of the premises and furnishing current to the different motors, of which the boiler pump and condenser motors take the largest amount of power, besides the coal-conveyer. The direct-current machines of these groups are of the eight-pole type, working at 1,700 amperes and 225 volts, which latter is the standard direct-current voltage of the station. Besides the two main rotary groups is a small booster set, which consists of two six-pole, direct-current machines of similar build, mounted on the same shaft. The booster is intended to be used with the large storage battery of the station. The latter will have 126 cells, giving a total capacity of 1,300 ampere-hours on a one-hour discharge rate.

In the rear of these rotary sets and under the iron staircase which leads to the floors of the annex building is a switchboard which is used for operating the converter sets. This board has sets of panels for the high-voltage three-phase current coming to the motors and other panels for handling the 225-volt direct-current circuits of the generators. At present there are ten panels of gray marble erected, having the voltmeters, ammeters and switches mounted at the upper part, while in the lower part of each panel is placed a rheostat wheel.

Each of the main turbine groups is provided with an instrument column which is placed near it so that the attendant can see at a glance how the alternator is running and also at a considerable distance. At the top of the column, which is some eight feet high, is mounted a large dial which faces both ways alike, so that it can be read from either side. The dial contains a voltmeter scale reading up to 12,000 volts which shows the main voltage of the machine, and beside it is an ammeter scale reading to 400 amperes. Below is a scale showing kilowatts and going up to 7,500 kilowatts. The instruments are all mounted inside the case between the two dials, and thus show the readings both on the front and back. Under the main dial is mounted an Aron meter which indicates kilowatt-hours on a set of dials. On the main cast-iron pillar supporting these instruments is a projecting switch handle for cutting off the current.

An interesting mechanical feature is the assembly of four different machines of large size, mounted on the same shaft. The new group is known as a "polymorphic" set, that is, it is capable of furnishing two-phase or three-phase current at the two different frequencies which were adopted as the standard for the plant, as well as supplying direct current for various circuits. All of these different currents are not supplied at the same time, however. Either the three-phase or the direct-current machines can be used as motors, from the bars of the station, thus driving the others as generators. This group, which is shown in Fig. 8, has been designed and built by one of the well-known French electrical companies, the Societé Parisienne Électrique, whose works are located at Jeumont, in the north of France, and was assembled by M. Pierre Flamant.

Upon the main shaft of the group, which has an unusual length and is supported in six bearings, are mounted the two alternators and the two direct-current generators, placed as follows: first comes a generator (in the foreground) which is designed to operate on 500 volts. After the second bearing is placed a three-phase machine working on twenty-five cycles and 10,500 volts. Lying next to it is an alternator having a somewhat similar appearance in general, but designed as a two-phase machine working on forty-two cycles and 6,000 volts. Between the two alternators is mounted a magnetic clutch which is used to separate the halves of the group, formed each of one generator and one alternator. After the forty-two-cycle machine is placed a generator, which is the last of the series and is of the same type as the first generator. The twenty-five-cycle machine may receive three-phase current at 10,000 volts from the station bars, and drive either or both of the generators so as to furnish 500 volts direct current. The three-phase motor can also be used to operate the forty-two-cycle machine lying next it, and the latter will thus give two-phase current at 6,000 volts.

In general, the twenty-five cycle machine is used as a motor from the station bars. The group is started up by running either of the 500-volt generators as a motor on the 250-volt circuit of the station. The generator thus brings the three-phase, twenty-five-cycle machine up to speed, and when at the right point this machine is thrown on to the three-phase circuit of the station, and is thus made to run as a motor, in which case the direct current is cut off from the generator. The three-phase motor is now prepared to run the forty-two-cycle machine, either alone or in combination with one or both the direct-current generators. Usually this is the method on which the above group is operated.

The polymorphic group is operated at a normal speed of 500 revolutions per minute, and it is able to furnish a total capacity of 2,500 horse-power with the maximum grouping of the machines. It is to be remarked that the twenty-five-cycle machine is operated as a synchronous motor. The twenty-five-cycle, three-phase alternator has a total capacity of 1,500 kilowatts or 1,675 kilovolt-amperes when operating at the normal speed. It is designed to run on 10,500 volts with $\cos \phi = 0.895$, and in this case it will furnish a current of ninety-two amperes. With $\cos \phi = 1$ it will give 82.5 amperes. The exciting current for the field is fifty-seven amperes and 225 volts. The second alternator, which gives forty-two cycles, when running at the above speed develops 1,850 kilovolt-amperes with $\cos \phi = 0.81$, which is the usual condition of working, and in this case it has a capacity of 147 amperes. The working voltage is 6,300. To excite the fields of the machine seventy-five amperes and 200 to 225 volts are required, which latter current is taken from the station bars. This alternator is constructed on the general lines of an exterior slotted armature ring and an internal field with projecting poles. The field is formed of a steel drum keyed to

the shaft and carrying eight poles around the periphery. About the usual method is used in mounting the field coils and current is brought into them by a double steel ring collector mounted on the shaft. On the inner face of the laminated ring which forms the stator of the machine we find the usual system of lathe-wound coils placed in slots. In the view the end cover has been removed and the projecting ends of the coils can be seen. Extra heavy copper bars make up the coils, and there are nine slots corresponding to each pole. A section of about one inch wide and one and one-half inches deep is given to the slot. The main diameter of the machine is about nine feet and its width five feet. The diameter of the revolving field is about six feet.

The general design of the forty-two-cycle alternator is about the same as the foregoing, except that the dimensions and the form of the windings are somewhat different. There are ten poles on the revolving field, which has an outer diameter of five feet. Around the field is a laminated ring containing six slots per pole, with a slot section about the same as before.

Both the direct-current machines are of the same construction. They are eight-pole machines of the drum-armature type, but the method of designing the fields shows some original points, as here there is a set of auxiliary poles which are placed so as to present sparking of the commutator. The eight principal poles of the generator have a compound winding, and the series winding consists of several turns of a one and one-half-inch copper strip which is wound on a separate spool lying between the main winding and the field iron. Between the main poles are placed the extra poles which are thus also eight in number and occupy the middle spaces. These poles are of a smaller diameter than the others, and contain a winding of eight turns per layer, of copper strip about one and one-half inches wide. A copper ring runs around the machine near the field coils to connect all the auxiliary poles, and a similar ring is used with the series winding of the main poles.

On the middle of the commutator is a steel ring of large section which is separated from the bars by a thick layer of mica. Like steel rings are used at each end of the commutator. The high speed of running made these precautions necessary. A large steel ring frame passes around the middle of the commutator, so as to hold the brush-holders, which are eight in number on either side. When running at the standard speed of 500 revolutions per minute the generators are wound for 500 volts and have a capacity of 1,400 amperes. The maximum output of these machines is about 750 kilowatts.

The arrangements for handling the different circuits of the St. Denis station are carried out in the most complete manner and all the apparatus has been carefully designed with a view of handling the large amount of power which is furnished by the plant with simplicity as well as safety. A large annex wing has been added in front of the main building, and it is entirely devoted to the circuits and switching apparatus, along with a room containing the storage batteries. As this part of the plant has only been finished recently the present account of the switchboard apparatus and the views which we show here are first to be published about this part of the station. The annex has four stories, including the basement, and the four lower stories are di-

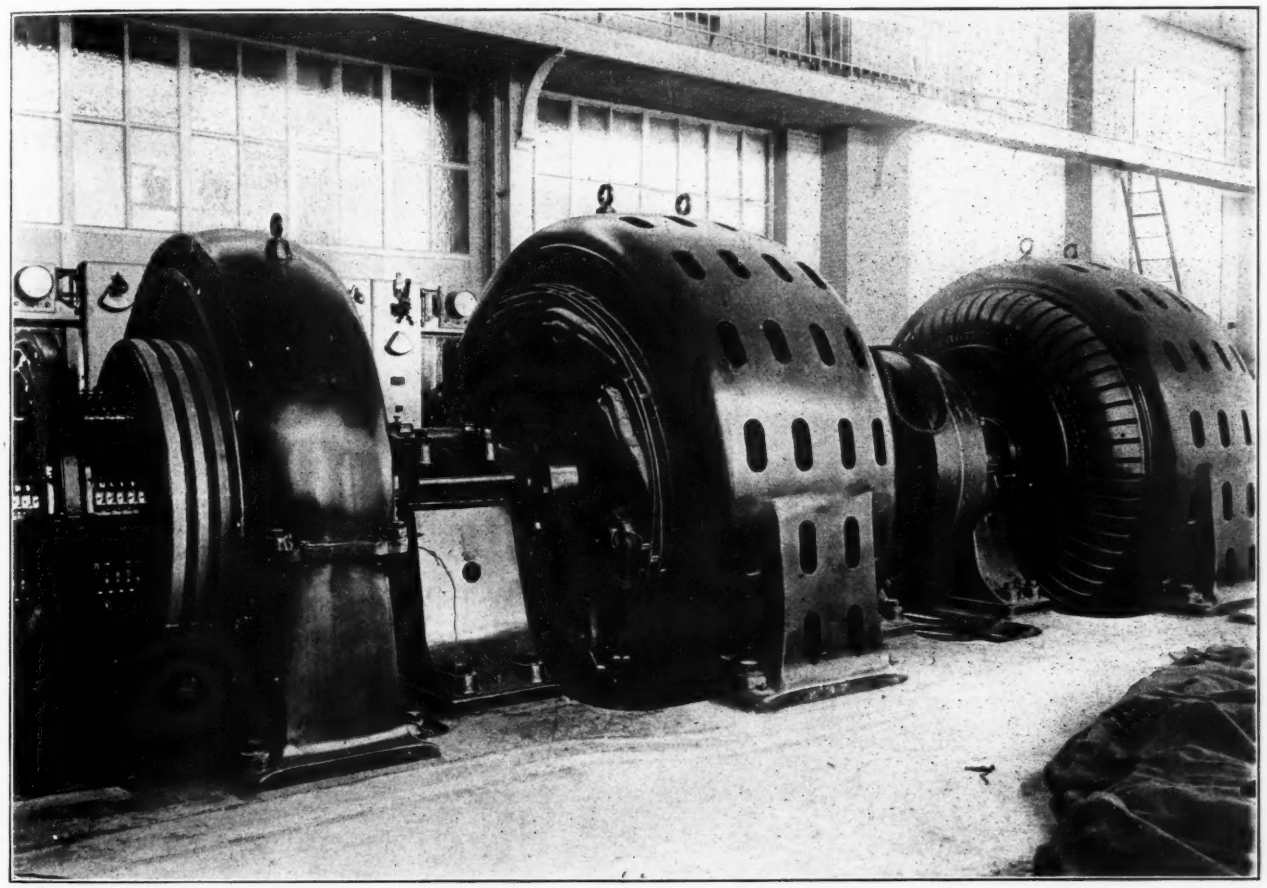


FIG. 8.—POLYMORPHIC SET, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

vided by a partition in the middle, thus making eight separate rooms for the current bars and other circuits of the plant, along with the switching apparatus, rheostats, lightning arresters and other apparatus belonging to the switchboard. The top floor, which lies three stories above the main dynamo hall, is laid out in a single large floor, and here have been installed the series of panels which contain the operating levers and instruments for handling the apparatus below. From this point the attendant has a good outlook over the dynamo room, and can observe all the machines, exchanging signals, if need be, with the engineers.

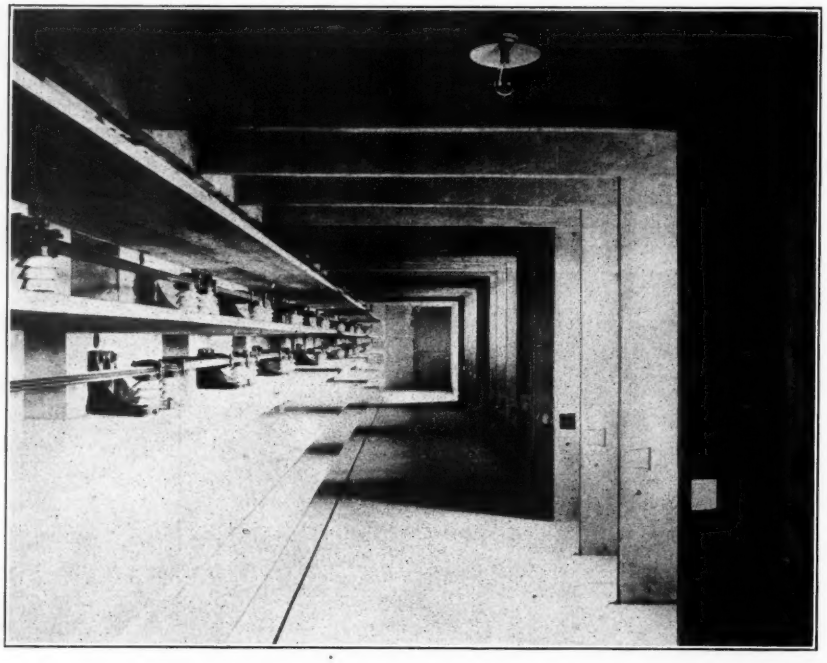


FIG. 9.—MAIN BUS-BARS, SWITCHBOARD ROOM, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The switching apparatus contains many novel and interesting features, and may be taken as representing the most recent progress which has been made on the Continent in this direction. In general, the main alternator groups of the plant are run upon two different sets of bus-bars which form the principal bars of the station. One of these sets consists of the main bars and the second set forms the auxiliary bars. Current is switched from one to the other set, as is desired for operating. The six main rooms of the annex are fitted up to contain the bars, special care being given to mount them in the proper manner so as to have a good insulation for the 10,000-volt circuits and keep them well separated. Fig. 9 shows the arrangement of a switchboard chamber. The bars are held at the proper intervals by triple-porcelain insulators mounted on a cast-iron bracket. The bars are sectioned at intervals, and proper arrangements are provided for connecting the sections together. These rooms are well aired and are lighted either by large windows or by lamps.

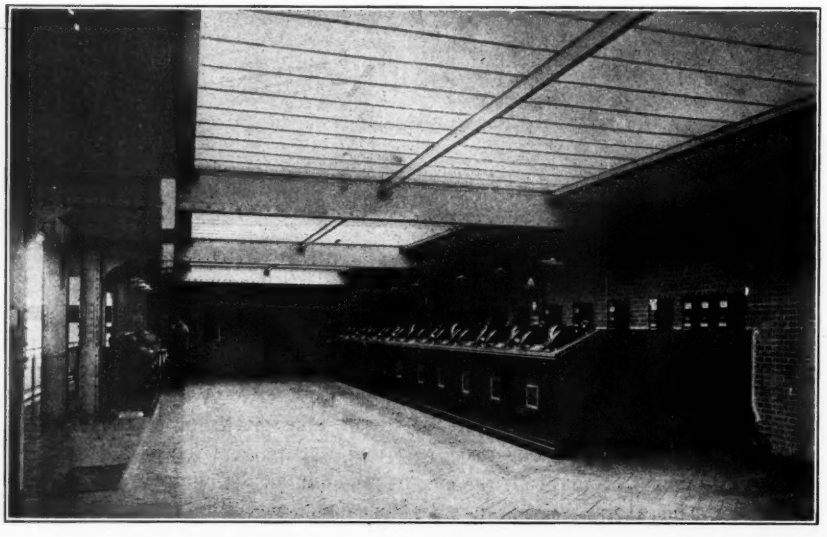


FIG. 10.—CONTROL SWITCHBOARD, ST. DENIS ELECTRIC GENERATING STATION, PARIS, FRANCE.

The switchboard control apparatus, which has been designed by the Brown-Boveri firm, is mounted upon a form of desk panel, having a slanting top (Fig. 10), this forming a continuous bench. The panels are of black marble and are mounted in metal fittings of black enamel finish. With the handles of the instruments and the various metal parts nickel-plated, the whole presents a very handsome appearance. On the top of the panel are mounted most of the handles and the indicating instruments. Electrical and mechanical control is used for operating the various devices of the switchboard from these benches. Along the rear wall of the room runs the bench which is used for handling the feeder circuits, while in front and next the dynamo hall is placed a shorter bench, consisting of five panels for operating the machines. Each panel of the bench forms a separate unit, both for the machine and the feeder benches. A certain number of units, such as are needed for the present capacity of the station, have already been assembled, but a large space is left in the hall so that a great number of panels can be added on to the ends of the rows from time to time, as the extension of the stations may require.

Where two or more of the alternator groups are operated in parallel, it is not necessary to use all the panels which belong to these machines, seeing that in this case a special panel has been provided. After starting up the machines and bringing them into synchronism they are thrown in parallel, and then can be operated from the special panel. On the vertical front is mounted a large rheostat wheel which uses a transmission device so as to allow all the rheostats of the machines to be operated from this point. The top or desk part of this panel contains simply three ammeters of the sector pattern,

reading up to 3,000 amperes. Below the rheostats of the machine panel is a specially designed instrument which is intended to act as a circuit-breaking device for breaking the current in the fields of the alternators in the case of a short circuit, but it does not act for an overload. A set of disks working in a revolving field is used for this purpose, and the device acts as a relay to operate a solenoid switch placed in the lower stay. A glass panel in front allows of inspecting the instrument.

As regards the feeder panels, the same general design prevails. Each panel of the bench contains the apparatus for using either the main set of bus-bars or the auxiliary set.

At present there are ten feeder panels mounted in the station for use with the feeders which the plant is now supplying, with two others left in reserve. An additional panel is used to supply that part of the city system which is operated by the Continental Edison Company.

Separating the feeder panels from the rear wall is a space of four or five feet, and the flooring is elevated about a foot so as to allow for the different connections from the bench to the wall and thence down to the lower floors. Against the wall is a continuous shelf containing a set of meters, one for each feeder panel. These meters are of the Aron type, with automatic electric rewinding system, working on a maximum of 53 by 165 amperes and 10,250 volts. Behind the Edison feeder is mounted a very elaborate system of registering wattmeters. One of these is a three-phase wattmeter which registers up to 2,000 kilowatts. Below it is mounted a large instrument, some three feet square, built by the C. Olivetti firm of Milan and using a pen recorder to register to 2,000 kilowatts with a maximum of 150 amperes.

Glasgow Telephones.

The purchase by the British post office of the Glasgow Corporation's telephone enterprise has at last been effected after a protracted series of negotiations. Full particulars concerning the deal appear in another column, but it is significant to note that the amount at which the concern has been sold is nearly £20,000 less than the sum offered by the National Telephone Company. The latter company proposed to pay the book value of the asset, which stood at over £320,000. It is estimated that the loss which will fall upon the shoulders of the ratepayers as a result of the present deal will amount to about £15,000. It appears from the agreement arrived at between the post office and the Glasgow corporation that the former undertakes to maintain the existing rates to subscribers for two years. There are now four municipal systems in existence—Brighton, Portsmouth, Swansea and Hull—and it remains to be seen what effect the Glasgow purchase may have upon the negotiations which are going on for their acquisition by the government.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

THE MEETING OF THE MINING INSTITUTE.

At the recent annual meeting of the Institute of Mining Engineers in London, electricity was again very much to the fore. There were no less than four papers out of thirteen devoted specially to electrical apparatus, and in some of the other papers electricity came in occasionally. Mr. Mountain had another paper upon the question he has been thrashing out, as to the commercial possibility of electrical winding, in which he returned to the charge, as against his German critics, with some fresh tables. The discussion on this paper brought out the fact that winding by electricity is being seriously considered by mining men in the United Kingdom, and that in a number of instances it is actually in use with economy. The manager of some shale mines in Scotland mentioned the fact that in one of their mines they were winding by steam, and in the other by electricity, transmitted from a generating station, three-quarters of a mile away, and they found that the electrical winding was cheaper. The depth in this case was very small, only 140 yards, and the quantities of mineral wound were small in comparison with the quantities wound in the large collieries at the present day, but it is just in these smaller cases where probably electrical winding will first establish itself, and where the experience will be made that will finally enable it to be used generally. In Germany, where it has taken such a great hold, the criticism is made that the mines do not turn out much. Professor Redmayne also mentioned that he had gone very fully into the question of winding, and working a new colliery generally by electricity, for two shafts, 500 yards deep, that are about to be sunk in South Wales, from each of which 1,200 tons per day will be drawn, and he stated that he had come to the conclusion, absolutely, that electricity would be cheaper for all the work of the colliery, and they were going to adopt it everywhere, except for ventilation. It was pointed out in the discussion that the running of the ventilating fan by an electric motor from a three-phase service is the weak point of the electrical working of collieries. The economy of the question turns upon whether there is steam in the immediate neighborhood of the fan or not. If there is, the most economical arrangement is to use the steam directly to drive the fan engine, as there is no steam economy that can be adopted to generate electricity that can not be adapted directly to the fan engine. With three-phase motors also there is the objection that they do not readily lend themselves to the variation of speed that is sometimes required with the fan. It is usual in most collieries to lower the speed of the fan engine at week ends for two reasons: to economize in coal, a smaller quantity of air being sufficient when there are no men in the pit, or only a few repairers, and also because English mining practice prefers to have as small an air-pressure as possible on the coal faces. The view of experienced English mining engineers is that it is better for any gas that is likely to exude from the coal to come away and be carried harmlessly up the upcast shaft, than for it to be imprisoned in the coal, possibly acquiring pressure and being given out in large quantities in case of any disturbance of the ventilation at any particular point. In addition to lowering the speed of the fan at week ends, it is the practice to vary the speed occasionally with varying barometric pressures. The variation is small, and it could be accomplished by putting a resistance in the rotor circuit of the motor, as is done with some electrical haulage plants, but this would be so obviously wasteful considering the time the fan is running, that it does not meet with favor. It appears to me that the solution of the problem would be to convert the three-phase current by a rotary converter or motor generator, and to drive the fan by a continuous-current motor, regulating the speed by adjusting the resistance of the field-shunt coils in the usual way. There are other apparatus about a colliery that would be more conveniently driven by continuous-current motors for the same reason. It may perhaps be noted that the fan load is almost the ideal. It is an even better load than that of the ocean steamer, inasmuch as it is practically constant for days together, and is continuous day and night for every day throughout the year.

The next paper dealt with electrically driven air-compressors, the air being used for working coal-cutting machines. This arrangement, which was adopted in Germany a good many years ago, practically solves the problem for the present of the difficulty of using electrically driven apparatus at the face of the coal in fiery mines, and the enormous losses incurred in the transmission of compressed-air under ordinary conditions. The net efficiency of compressed-air when the air is compressed on the surface and transmit-

ted by pipes to the face of the coal is rarely over twenty-five per cent, and may be as low as seventeen per cent. It is possible to obtain higher efficiencies if the air can be reheated at, or near the face, but in fiery mines this is of course impracticable. The great source of loss in transmitting compressed-air is the leakage from the pipes. As I have before pointed out in these notes the roadways of a mine are constantly "working," with the result that considerable strains are brought upon the joints of the pipes. In addition, the pipes themselves are often buried by the débris, coal dust, etc., on the main roads, and any air leakage, which would be difficult to see under any circumstances, is completely hidden. By placing the compressor near the face, and transmitting the power by electricity, this heavy source of waste is eliminated. The combined efficiency between the steam engine driving the electrical generator on the surface and the indicative horse-power in the air-compressor underground being given at from sixty-two to sixty-four per cent. As was pointed out in the discussion, there is an alternative to the method. Flexible metallic tube might be employed to transmit the air from the surface to the coal-cutting or other machines to be driven by it. It is probable that the leakage would be almost eliminated if flexible metallic tube was employed. On the other hand, the flexible tube is very expensive, and it is really a question for the usual balance sheet, placing on the one hand the first cost and upkeep of the flexible tube, on the other hand the cost of the generator or the proportion of the generator employed, the cables, the motor, the switch gear, etc. The method of compression near the face of the coal has the disadvantage that it is not possible to work the air isothermally, or in any way approaching to it. That is to say, it is not possible to make any attempt to extract the heat from the air, as it is generated during compression, and this must materially reduce the efficiency of the air-compression system, as the expansion of the air causes a smaller quantity of free air to be taken into the compressor at each suction stroke. In connection with the use of compressed air, an old suggestion of my own was brought up in another paper, that by Sam Mavor—the air might be heated by electricity transmitted from the surface. I have not had time to examine the economy of question in the light of later knowledge, but the following figures will enable anyone that is interested in the subject to do so. One British thermal unit will raise the temperature of fifty-five cubic feet of air at about sixty degrees Fahrenheit, one degree Fahrenheit. A kilowatt contains approximately fifty-seven heat units. Air at sixty degrees Fahrenheit expands by $\frac{1}{461}$ of its volume for every degree of increase of temperature.

Another paper devoted nominally to electricity was by a colliery manager, who has made a rather exhaustive study of electricity, on the adaptation of a Rateau three-phase turbo-generator, supplied with steam from the exhaust of the winding engines. Professor A. Rateau, of the École Superieude des Mine, of Paris, has worked out a system for the use of the exhaust steam from winding and other engines, in low-pressure steam turbines. The essence of the invention is really in the thermal storage apparatus which he has worked out. The exhaust from a winding engine is intermittent. On the other hand the demand for current from the generator driven by the steam turbine, varies, and the thermal storage or accumulator, as Professor Rateau calls it, acts virtually as the receiver of an air compression system does, or as the accumulator in the modern generating station, with Highfield booster. The accumulator consists of an old boiler, or any convenient cylinder of a similar kind, partially filled with a mass of scrap iron, old pit rails, etc. There is water in the cylinder, occupying a portion of the space not filled up by the scrap iron. The exhaust from the winding engine is delivered to the accumulator, and the turbine receives its steam also from the accumulator. The exhaust steam causes the water in the accumulator to generate steam, and the heat which it brings is taken up very largely by the scrap iron. When the winding engine stops for a certain time, the scrap iron gives up its heat to the water surrounding it, maintaining the steam pressure in the accumulator, until the exhaust steam is delivered to it again. For driving the turbine at any time when the winding engine is stopped for a long period, a connection is made to the boiler service, through a reducing valve, and when the pressure in the accumulator falls to a certain figure, the connection to the boiler service is opened, and the turbine is worked directly from the boiler at the reduced pressure. At the Hucknall colliery in Nottinghamshire, where the apparatus is at work, it is stated that there is no appreciable variation in the speed of the turbine, whether it is fed with live steam from the boiler, the exhaust steam from the winding engine, or the regenerated steam, as it is called, produced by the delivery of heat to the water in the accumulator from the scrap iron. One point that is of interest in this matter, seeing that the question of winding by electricity is so much to the fore at present, is, that it is considered unsafe by colliery managers to allow a condenser to be connected to the winding engine when men are being raised or lowered. In the mines in the United Kingdom, the home office makes very stringent regulations as to the winding of men. When coal only is being pulled up, or empty mine wagons lowered, the arrangements may be very much looser than when men are being wound. At the Hucknall colliery, where the Rateau apparatus is in use, the cost per unit is stated to be 1.3 pence when working 250 days per annum, and after allowing ten per cent for depreciation. It is stated that if the turbine ran at full load for the 250 days per annum, the cost per unit would be reduced to 0.55 penny. The quantity of electricity generated is not large, 230 board of trade units per day, of which twenty-seven units are consumed by the underground service. The cost of generation in this case strikes me as high. There are a great many mines in the United Kingdom that are generating current at a very much lower figure than either of those named.

The fourth paper was by the writer, on "Capacity Current and its Effect on Leakage Indications on Three-Phase Services." In the correspondence in discussion of the paper I read at the Mining Institute meeting in Manchester last September on "Earth in Collieries," the question was raised as to whether it was possible to distinguish between capacity currents discharging through the indicating apparatus, and leakage currents proper, in the case of a three-phase service. One gentleman who has an electrical plant under his charge stated that he had an apparent leakage of thirty-three milliamperes from each of his three cables, but that an expert who had been called in stated that they were really capacity discharge currents. I was requested to explain the whole matter, and to say how the difficulty was to be met. In my paper I pointed out that as the algebraical sum of the currents of a three-phase system at any instant is zero, the capacity currents should also be zero, providing that the capacity of the three cables is alike, and that therefore, if any cable is injured, its capacity is altered, and it really makes very little difference whether you consider that you are measuring an actual leakage current, or a difference in the capacity current, providing that you

understood that the difference is caused by damage to the insulating envelope of the cable. With any one of the leakage indicators on the market, there would be no indication as long as the indicator was connected, either to the neutral point, or to a neutral point formed by connecting three resistances to the three cables, unless the capacity of one cable is altered, and it is then a simple matter to test the three cables. There is, however, a case where this is not correct, viz., where the characteristic of the service is not a true sine curve. As I understand, the tendency of modern generators, and modern alternating systems generally, is toward pure sine curves. In some of the earlier apparatus, this was not so. It is possible to resolve every curve, however irregular it may be, into a number of sine curves, of which the first curve, or first harmonic, represents the principal portion of the energy of the service. The second and fourth harmonics go out by cancellation, and the third and fifth harmonics are the only ones likely to give trouble, and then only if the separate curves of each harmonic of the three phases are in phase with each other. When that happens you may have a comparatively large discharge current, and I have been informed of cases where there is such a discharge current. The only remedy appears to be to ascertain the curve of the system with an oscillograph, and if it is worth the expense, to have the generator and transformers altered, so that an approach to the sine curve may be obtained. In the great majority of cases it appears to me that the third and fifth harmonics of the three phases of the service would probably not be in phase with each other, so that the algebraical sum of their capacity current, or the resultant curve, would be very small indeed, and not worth troubling about. In the discussion, the question was raised about the case where the neutral of a three-phase system is earthed. The board of trade in the United Kingdom and the home office in its control of electricity in mines, do not demand exactly the same arrangements. The home office allows the neutral to be connected to earth, if the mine management so chooses. The board of trade says that the neutral of a power service must be earthed. It was suggested by the engineer of the Lancashire Power Company, that a very low-resistance ammeter might be inserted in the wire, connecting the neutral with earth, the ammeter being fitted with several shunts of varying values, so that leakage indications of greater and greater quantity might be obtained by successively switching on the different shunts. It is merely an adaptation of the form of ammeter, now commonly employed to this service, with the provision of a number of shunts of varying multiplying power, and should answer very well.

THE COLLIERY EXHIBITION.

This exhibition is getting to be an institution held biennially in London, at the time of the annual meeting of the Institute of Mining Engineers. Electricity is very much to the fore at the exhibition. The principal firms who cultivate mining work, the Westinghouse Electric and Manufacturing Company, Lahmeyer & Company, Messrs. Ernest Scott & Mountain, The Brush Company, Mavor & Coulson, and others, had large stalls. Coal-cutting machines are undergoing an important modification. The chain long-wall machine, which was introduced over here some years ago by the Morgan-Gardner Company, has caught on. The Morgan-Gardner machine has apparently failed to satisfy the requirements of mining work, and I understand has been almost entirely withdrawn. On the other hand, the Austin Hopkinson machine, which is almost identical with the Morgan-Gardner, is doing good work. Mr. Hopkinson told me that he had sold twenty machines within a very short time, and that he had not had a single armature burned out. As shown at the exhibition, his machine looks very strong and suitable for the rough and tumble of colliery work. I gathered that he only uses series-wound continuous-current motors, and that he constructs them with specially long armatures, of small diameter, so that if they do race (one of the complaints that is made against the series-wound motor) it is not a serious matter. The three-phase driven coal cutter he makes with a very large rotor slip, and I understand that he finds it able to cut its way into the coal, and to deal with anything in the way of hard stuff, or pyrites, with a squirrel cage motor. For starting, he has an auto transformer. The switch is enclosed, and is operated by a substantial rod with a hook at the end, by which it is pulled either into contact for regular working, for starting, or for stopping. The Diamond Company have also introduced a chain machine, run on the same lines as the Hopkinson and Morgan-Gardner, but while those firms only have one motor, the jib or frame carrying the chain being at one end of the machine, the Diamond Company have two forms, one with two motors, the frame carrying the chain being at right angles to the body of the machine, and another form in which only one motor is employed, the arrangement being similar to that of the Morgan-Gardner and Hopkinson. The Brush Company had an electrical coal-cutting machine on view. It is a disc machine, and a modification of the Diamond machine with two motors, the disc being held in the centre of the machine between the motors. The Brush Company claims certain improvements in details, one of which is the employment of ball bearings on the main driving shaft, and a special arrangement of feed for the haulage gear. Another noticeable development in connection with all the coal-cutting machines now on the market is the adoption of "skids" in place of rails. One of the difficulties in connection with the working of coal-cutting machines has always been the laying of the rails for the machine to run on. Messrs. Mavor & Coulson have always insisted that 100 yards of face should be prepared in front of the machine, and that the rails should be laid well ahead. Other makers employ only three pairs of rails, one pair on which the machine is standing, a second pair laid immediately in front, to which the machine will move as it leaves its present pair, and a third behind, which, as it moves, the man behind picks up and passes over the machine to the man in front. There is considerable trouble in laying the rails, so that the wheels of the machine will take them, and if it does not take them properly, there is trouble with both the haulage gear and the cut. If the rails are laid properly, the friction is of course considerably less than with "skids." On the other hand, "skids" will adapt themselves to the inequalities of the floor, and the increased power demanded by the haulage gear, which pulls the machine along, is not of any consequence compared with the greater convenience of cutting. A paper that was read by Mr. Mavor, of Mavor & Coulson, on practical problems of machine mining, was a plea throughout almost its entire length, and it was a very long paper, for greater care in preparing roads for coal-cutting machines, greater number of gate roads; the roads, usually made up of loosely packed rubbish, by which the coal face is approached, and a greater number of cross-gate roads joining these. He also pleaded for cutting in the coal in place of cutting in the fire clay that usually underlies the coal. The relative advantages are, by cutting in the fire clay the whole of the coal in the seam should be obtained in the form of round coal, with very little small. On the other hand, cutting in the fire clay requires more power than cutting in the coal, and the coal dust does not create friction in the working parts of the machine; so that the machine is therefore

able to continue running for longer periods than where it is subject to the fine dust formed when cutting in the fire clay. At the exhibition, the Lahmeyer Company exhibited a form of controller, for three-phase main and tail haulage, worked by a lever at the end of a pair of H girders, the lever being arranged to occupy the usual position at the engineman's hand. The lever moves longitudinally between the girders, and in so doing revolves the controller, this being enclosed in a substantial iron cylinder, fixed at right angles to the girders. The lever also moves transversely to the girders, and in so doing operates the reversing switch contained in a box attached to the girders, fixed between the lever and the controller. The switch and controller works in oil. The engine man has all the motions under his control by different motions of one lever. The controller is arranged to throw different resistances into the rotor circuit, and the motor it controls is wound for only two phases, while the stator is wound for three phases. They claim to be able to reduce to half-speed, by any convenient steps that are required. The efficiency at full speed is stated to be ninety-one per cent at half speed seventy-two per cent. The Westinghouse Electric and Manufacturing Company showed an earth detector for three-phase services of 3,000 volts and upwards, which appeared to me to be on the right lines. The conductor of each cable is connected to a small condenser, and the outer conductors of each condenser all connected to electro-static apparatus, whose needles indicate a difference of pressure between each phase, and earth. The electrostatic apparatus consisted of light aluminum vanes, carrying pointers which moved over scales graduated up to 3,000 volts in either direction, the vanes being suspended between two copper enclosing pieces. The vanes are connected to earth, and the two enclosing pieces to two of the phases. Two instruments are fixed side by side, two phases being connected to each instrument, so that full indication is obtained of any phase to earth.

Professor A. J. Pollock and S. H. Barraclough, of the University of Sydney, in a paper before the Royal Society, of New South Wales, described a hollow lightning conductor crushed apparently by the electrodynamic action of the current. The tube was 1.8 centimetres in diameter, 0.1 centimetre thick. Assuming the material was plastic at the time of crushing, the current is calculated to have been about 20,000 amperes; if not, the current would be about 100,000 amperes.—*Nature.*

THE POWER PLANT OF THE ELECTRICAL DEVELOPMENT COMPANY, OF ONTARIO.[1]

BY F. O. BLACKWELL.

The power plant of the Electrical Development Company was designed to utilize 11,200 cubic feet per second of water under a head of 135.5 feet. The water is diverted from the Niagara river at Tempest Point, midway between the headworks of the Ontario Power Company and the Canadian Niagara Falls Power Company.

The general plan of development adopted called for the construction of a wing wall to gather the water from the rapids, the excavation of a forebay of sufficient capacity with the river at its lowest future stage, a wheel pit, and a tailrace tunnel discharging under the centre of the Horseshoe falls, where the flow of water over the falls is greatest.

The forebay in the rapids and the tunnel outlet under the falls were both bold and original conceptions, which were thought at the time to be practically impossible of execution.

In order to uncover the forebay it was necessary to construct a coffer dam 2,200 feet long in the rapids, where for a portion of the way the cribs had to be sunk in water twenty-six feet deep and running at a velocity of twenty-two feet a second. This work was started in April, 1903, and proved to be an extremely difficult undertaking, but was successfully completed in about twelve months.

The tailrace tunnel was started in May, 1903, by the sinking of a construction shaft on the bank of the river 150 feet deep and fifteen by seven feet inside the timbering. From this shaft a drift fourteen feet wide and seven feet high was run 670 feet to the portal of the tailrace tunnel, work upon which was only actually started in December of the same year. The final opening under the falls proved very difficult on account of the large amount of water encountered near the face and the mass of detritus that had to be cleared away by men exposed to the full force of the wind and spray from the falls.

The wing dam is 785 feet long, and its maximum height is twenty-seven feet. The elevation of the crest is 527 feet, and there will be from three to eight feet of water flowing over it, depending upon the condition of the river. Near the power-house the dam is cut away for a length of thirty feet to an elevation of 524 feet so that there will be three feet additional depth of water to carry away ice from the submerged arches in front of the power-house. This question of guarding against ice is one of the most important problems which had to be met. In addition to the first line of submerged arches just referred to, a second wall has been constructed outside of the racks. The spaces between the outer and inner walls, and between the latter and the racks, are arranged each with a spillway at one end, so that such ice as passes through will float out at the north end of the building.

The wheel pit is 416 feet long and twenty-two feet in width inside of the brick lining, which is two feet thick, and is spanned by masonry arches at three levels to carry the machinery. The ends of the pit are also closed by arched wall linings. The arches were not allowed to be put in until the pit had closed in as much as it would and come to rest. There has been no movement whatever at the union of the arches and the walls that the most accurate observations could detect, which is interesting on account of the theory once advanced that there was a periodic change in the distance apart of the sides of the pit.

For the power to be developed the length of the wheel pit is much less than in previous developments of this character. This is due to the penstocks alternately being on the right and left-hand sides of the water-wheels, permitting one hoistway to serve two wheels.

The water after passing through the racks enters a cast-iron bell-mouth, which in turn joins on to a riveted steel penstock ten feet six inches in diameter.

There are eleven penstocks, and at the head of each there is an electrically operated gate to control the water. The penstocks are connected at the bottom to water-wheels of 13,000 horse-power capacity, running at a speed of 250 revolutions per minute. The wheels and penstocks rest on a heavy concrete foundation, which covers the bottom of the wheel pit.

The hydraulic apparatus is being furnished by the I. P. Morris Company, of Philadelphia.

Each wheel unit consists of two Francis internal discharge turbines five feet four inches in diameter. The discharge of water is to be governed by cylinder gates, and the weight of the moving parts will be partially taken by a water piston in the wheel. There is a single cast-iron draft tube nine feet in diameter for each wheel, and the units alternately discharge water underneath the east and west tailrace tunnels. The object of the under discharge is to seal the draft tubes and prevent loss of vacuum, no matter what

[1] Paper read before the Canadian Electrical Association, Niagara Falls, Ontario, June 20.

the elevation of the water in the tunnels may be, and without the necessity for a tailrace weir. By using two tunnels it is possible to shut off the water entirely from one-half of the wheels without interfering with the other half. By closing down the wheels, discharging water into either tunnel, that tunnel will drain itself, and there is no necessity for closing off the mouth of the tunnel. A gate is provided at the mouth of both tunnels, however, in case of extreme back-water, which has been known to be fifty feet above normal in the lower river.

As the wheel pit is not connected to the tailrace, the hydraulic apparatus can never be flooded out.

The tunnels on each side of the wheel pit are twenty-five feet deep, and vary in width from sixty-six to thirty feet, with a velocity of from fifteen to twenty-one feet a second. At a point about 150 feet north of the wheel pit the tunnels come together. At the junction the tunnel is thirty-five feet wide and twenty-five feet six inches high and tapers to a width of twenty-three feet five inches and a height of twenty-seven feet one inch, which section is carried to the edge of the falls, a distance of 1,935 feet. The slope of the main tunnel is .005, making the total loss about ten feet, and the velocity is twenty-six feet a second. The tunnels have a lining two feet thick throughout of concrete faced with brick, except for 300 feet at the north end, where the lining consists of concrete rings in six-foot sections, which are expected to break off as the falls gradually wear away. This is necessary, as the crest in the centre has been receding at an average rate of two and one-half feet a year.

The power of the water-wheels is delivered to the electric generators through vertical shafts 150 feet long, consisting of riveted steel tubes thirty inches in diameter between bearings and solid shafts fourteen and one-half inches in diameter at bearings. This shaft is held at three points in the wheel pit by steady bearings resting on concrete arches. At the upper end there is an oil thrust-bearing thirty-seven and one-half inches in diameter fed by oil under a pressure of 350 pounds, which is sufficient to carry the weight of the entire revolving parts should the water thrust fail from any cause.

There will be ultimately eleven 8,000-kilowatt generator units, four of which are now being installed by the Canadian General Electric Company. These are of the revolving field type and run at a speed of 250 revolutions per minute. They deliver three-phase alternating current at a periodicity of twenty-five cycles and a potential of 12,000 volts. There are at first to be two 500-kilowatt water-wheel driven exciters in a room underground, and two motor-generator sets of the same capacity on the generator floor. Eventually three sets of each type will be installed, any two of which will excite all the alternators.

The controlling switchboard for the entire plant, including transformers and transmission lines, is located in the centre of the power-house, where the operator can see the generators. It consists of an enclosed compartment with a bench-board in front and doors at the ends. The instruments which are ordinarily employed in the operation of the station face toward the generator room. On the back are the recording instruments and switches, which are only occasionally used or referred to. Dummy bus-bars and signal lamps on the bench-board clearly indicate to the operator the connections in the station, and the instruments are so located that they are over the switch which controls them. The generator instruments, for instance, are over the generator control switch. The board is so compact that an operator standing in front of it can see all the instruments from one position, and can conveniently reach all the controlling switches. The power-house bus-bars, generator oil switches, instrument and switch transformers are located immediately below the power-house floor in brick compartments. The wiring arrangement is such that a generator can either be connected to the bus-bar or to a separate outgoing cable. In ordinary operation the current from each generator will leave the building by the shortest possible route, and there will be practically no cables running the length of the power-house.

The power-house will be a handsome building in the style of the Italian Renaissance, about 500 feet long and seventy feet wide. The height will be forty feet, except at the centre and end bays. The centre bay will stand out from the face of the building, and, besides being the main entrance, will give room for the offices of the power company. On the inside it will afford space for the switchboard and auxiliary apparatus. The power and transformer houses are 1,817 feet apart, and will eventually be connected by four underground conduits. One conduit will be in reserve, and the plant will not be crippled unless two conduits should simultaneously fail.

At present two conduits only are constructed, each with sixteen four and one-quarter-inch ducts placed two wide and eight deep. The manholes are common to the two conduits, but are divided into two parts by a central partition, so that one duct system would not be damaged by a burnout on the other.

The cables required for the portion of the power plant first installed are six 500,000 circular mils triplex for 12,000-volt power, two 00 B. & S. for the switch motor bus-bars, two with forty-five No. 8 B. & S. wires for oil-switch control, two each of thirteen No. 12 and fourteen No. 7 wires for instrument connections. The cables are in duplicate, and either half of the ducts might be disabled without shutting down the power system.

The transformer house is on top of the bluff outside of the park limits, and is designed to accommodate fifteen 2,670-kilowatt transformers furnished by the Canadian General Electric Company, twelve of which are now being installed. These transformers are of the oil-immersed, water-cooled type, and are wound for 10,000, 11,000 and 12,000 volts primary and 60,000, 50,000 and 40,000 volts secondary. They will be connected in delta on both primary and secondary sides.

Each transformer is placed in a separate closed fireproof room, so as to minimize the fire risk and prevent the possibility of trouble in one transformer being communicated to others. The transformers are mounted on rails and arranged to slide out of the compartments into a gangway, where they can be readily handled by an overhead traveling crane.

The piping for oil and water is placed in the basement under the back of the building and on the wall of the transformer compartments.

The cables from the power-house are carried in ducts to a gallery above the transformers, where the 12,000-volt switches, instrument transformers and bus-bars are located.

The high-potential bus-bars, wiring instrument transformers and air switches for the 60,000-volt circuits are located in the room back of the transformers, and connected through the gallery floor to the high-potential oil switches on the floor above.

The outgoing transmission lines leave the building through porcelain bushings at the back, and are protected by lightning arresters on the wall below.

The wiring throughout is completely enclosed in brick compartments, the only openings being through asbestos doors placed at points convenient for inspection.

The transmission line to Toronto, con-

structed by the Toronto & Niagara Power Company, is built on a private right of way eighty feet wide, which can later be used for a double-track railway. With this idea in view, the line was located so that the maximum grade at no point need exceed one per cent, and the minimum radius of track curvature can be made as low as a quarter of a mile.

Two complete steel tower transmission lines will eventually be constructed, one only being erected at present. Each tower carries two circuits of 190,000 circular mils copper conductor. The standard distance between poles is 400 feet, although much longer spans are used in crossing rivers and ravines. For curves and long spans special extra heavy towers are employed, with double and triple insulators. The height of the standard tower is sufficient to support the lower cable at a height of forty feet from the ground. Fifty and sixty-foot towers are made by bolting extensions to the bottom of the standard towers, and are used wherever there are depressions along the right of way. In two places towers 150 feet and 175 feet high are required in order to cross navigable channels at the Welland canal and at Burlington Beach.

The copper cable consists of six strands with a hemp centre, and has a tensile strength of 60,000 pounds, and an elastic limit of 40,000 pounds per square inch. It was made by the Dominion Wire and Cable Company, of Montreal.

A large portion of the power is delivered to synchronous apparatus, the Toronto street railway employing rotary converters, and the lighting company synchronous motor-generator sets. The loss of power, when transmitting 10,000 horse-power to Toronto over each circuit, will be less than sixteen per cent, and either line can transmit 20,000 horse-power with less than twenty per cent loss should the other become disabled.

The insulators are fourteen inches in diameter and fourteen inches high, and are tested for a potential of 120,000 volts complete, or 60,000 volts on each of the three parts of which it is composed.

The transmission towers are heavily galvanized after all machine work upon the parts has been completed. They were made by the Canada Foundry Company, of Toronto, and the Riter-Conley Manufacturing Company, of Pittsburg, Pa. At points exposed to severe lightning the line will be protected by twelve-foot extensions carrying galvanized steel cable above the power conductors.

There will be three division houses along the line, dividing it into four sections, any one of which can be cut out for inspection or repair. The length of the line is about ninety miles, and the division houses will therefore be twenty-two and one-half miles apart. A lineman will control each section daily after the transmission is in operation.

The substation in Toronto is designed for fifteen 2,670-kilowatt transformers, and is similar to the transformer house at Niagara falls, except that there will be double low-tension bus-bars and a much larger number of feeder cables for distributing power throughout the city of Toronto.

The switchboard is located at one end for controlling the transmission lines, transformers and 12,000-volt circuits. This is equipped with dummy bus-bars with all necessary instruments.

In the plans of the Electrical Development Company every effort has been made to avoid any interruptions to the power service. No single accident or any probable combination of accidents is ever likely to shut down the entire plant. The double ice protection, twin tailrace tunnels, the extra 8,000-kilowatt water-wheel, generator and transformer unit, and the duplication of the transmission lines and of all auxiliary apparatus is with this end in view.

The engineering design of the plant is in charge of Dr. F. S. Pearson as consulting engineer. The water power development was planned by H. L. Cooper, chief hydraulic engineer, and the writer laid out the electric plant. The construction of the hydraulic work and power-house was originally under Beverly R. Value, and is now in charge of L. J. Hirt as resident engineer, and Walter Pearson as electrical engineer.

The transformer houses and transmission line were built by Robt. C. Brown, chief electrical engineer of the Toronto & Niagara Power Company.

The officers of the company are: president, H. M. Pellatt; first vice-president, Frederic Nicholls; second vice-president, William Mackenzie; manager, H. H. Macrae; secretary, H. G. Nicholls; treasurer, D. H. McDougall.

Among the developments for supplying electricity in Japan is the 40,000-horse-power hydroelectric plant of the Uji River Electric Power Company. The plant will be in the neighborhood of Kobe and will supply current for lighting and power to Kyota and the surrounding district. A water-power plant is also contemplated by the Hanshin Electric Railway Company.

POWER SUPPLY TO TRAMWAY SYSTEMS.[1]

BY S. J. WATSON.

The number of street tramways constructed or reconstructed for electrical working during the last few years has necessitated a large increase in the capacity of existing generating stations, or the provision of separate stations to supply the power. In papers read before this and kindred associations the pros and cons of separate *versus* combined stations have received attention. The principal argument advanced in favor of a separate station has been that provided the power required was above a certain amount, the cost of constructing a separate station would be as low and the costs of production much lower than with a lighting station, consequently no possible advantage could accrue to a tramway department by amalgamation with the lighting department for generating purposes.

With the rapid growth in the demands for light, power and tramways, and in the sizes of our generating stations and outputs, the costs of production have been considerably reduced, and an advocate for a separate station is rarely met with nowadays. It is still difficult to say what is the limit in the size of a station so far as low-production costs are concerned; the issue appears to depend entirely on the size of the units installed.

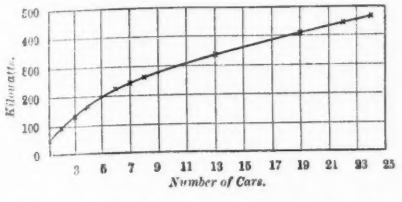
The writer does not intend to bring within the scope of this paper the question of supply to very large tramway undertakings; the following remarks are, therefore, intended to apply to small and medium-sized districts operating from six to thirty cars.

Capacity of Plant—When the construction of a tramway system is decided on, one of the first points to be settled is that of the provision of sufficient generating plant to maintain the service of cars under the varying conditions that a tramway system is called upon to fulfil if it is to satisfactorily deal with the demands of the traveling public. The principal requirements consist of an early morning workman's service between five and seven o'clock, a ten to twenty minutes' service between eight and noon, and a more frequent service from noon to eleven or half-past eleven at night; also, and this is of considerable importance from a power-supply point of view, a much-increased service for special local events. For a fairly hilly district the following curve may be used to obtain the

[1] Paper read at the eleventh convention of the Incorporated Municipal Electrical Association, London, June 22.

approximate maximum loads required from a plant supplying one to twenty-five cars in service on a regular time-table.

For a flat district the maximum would, of course, be considerably less than that shown, possibly by twenty-five or thirty per cent.



Relation of Load to Number of Cars.

To take as an example a system with twenty-four cars in use. From the curve above the maximum load will be 465 kilowatts, and where heavy special traffic has occasionally to be handled this should be increased by thirty-three and one-third per cent—say 155 kilowatts, making a total of 620 kilowatts. A separate power station to meet such demands would require as a minimum 750 kilowatts of plant, divided into three sets each of 250 kilowatts normal capacity. Allowing for twenty per cent overload for one hour, two sets would give a maximum of 600 kilowatts, the other set standing by as spare. The cost of such a plant, including site and buildings, would be £19,750, equal to £32.9 per useful kilowatt installed. To put down a direct-current plant capable of dealing with the same load in an existing station supplying alternating current, some reduction could be made in capital outlay. An extension of the buildings could be carried out for considerably less than the cost of an entirely new building. A full complement of boilers would not be necessary, as the new boilers would work in conjunction with those already installed. Altogether, a reduction in the cost of £3,500 should be made. The additional outlay to install the plant in an existing alternating station would be £16,250, equal to £27 per useful kilowatt installed. A further saving in capital outlay will be possible if such a plant is put down in a direct-current station already supplying light and power at 440 to 480 volts, as one of the existing steam sets could be altered at little expense to serve as the stand-by for both lighting and tramways, in which case there would be a saving on generating plant of about £2,250. The additional outlay for the installation of tramway plant in an existing direct-current station supplying at 440 to 480 volts would be £14,000, equal to £23.3 per useful kilowatt installed.

Type of Plant—From the supply point of view, a small tramway system provides one of the most severe loads that has to be dealt with, owing to the large and frequent fluctuations in the demand. With a system of the size mentioned, a variation from 50 to 465 kilowatts in a few seconds is not uncommon. It is therefore necessary to run a plant largely in excess of the mean load requirements, which seriously affects the economical efficiency of the works.

It has been the usual practice to provide generators to compound up from 500 volts no load to 550 volts full load, to compensate for feeder resistance. Such design is approximately correct for lighting and power distribution, but for small tramway systems it has little practical advantage, as the maximum load on one feeder may and frequently does occur at the same time as the minimum load on another. A constant pressure of 525 volts at the generating station will give the least variation at the cars, taking the system as a whole.

If there is one class of supply more than another where storage batteries can be used to advantage it is in connection with small tramway systems, but to enable the battery to be commercially successful in operation some regulating device is necessary to compensate for the difference in battery terminal pressure between the limits of full charge and full discharge. A considerable amount of attention has been given to the design of apparatus to obtain automatic battery regulation, and the cheapest and best method now in use is the reversible booster. With such a machine the full regulation mentioned above can easily be obtained, the line pressure can be kept nearly constant, and the generating plant run at practically constant load.

To supply a tramway of the size under consideration, a battery having a capacity of 250 kilowatts at the one-hour rate controlled by a reversible booster will be found an economical addition to the plant. It will then be possible to deal with the normal maximum loads of 465 kilowatts with the battery and one 250-kilowatt generating set running practically at constant two-thirds full load, instead of two 250-kilowatt sets each with a varying load averaging only one-third full load.

In a paper entitled "Economic Considerations in the Employment of Storage Batteries," read last session before the Manchester Section of the Institution of Electrical Engineers, J. R. Salter stated that there was no commercial advantage in using batteries in conjunction with steam plant when supplying power to a tramway undertaking using twenty-eight cars, and in support of his contention put forward the steam-consumption results obtained on steam plant when working with and without a battery. The conclusions arrived at by Mr. Salter did not appear such as could be generally applicable to other undertakings on account of the particular arrangement and cost of the plant tested. To obtain further information on the matter, the writer has carried out a number of tests on the plant under his charge, which is somewhat similar in size. The tests have been made to ascertain: (1) the cost per unit sold when running one 250-kilowatt set with a battery; (2) the cost per unit sold when running two 250-kilowatt sets without a battery; (3) the cost of running one 250-kilowatt set excited, but without load, including auxiliaries, such as condensers, pumps, etc. The object of the last test was to find the cost of running steam plant with little or no load in the early hours to supply workmen's cars and later at night for taking cars to the shed, which running is avoided if a battery is used.

The extra steam consumption when running two sets and auxiliaries without the battery compared with one set and auxiliaries with the battery was 4.75 pounds per unit sold. With an evaporation of 7.5 pounds water per pound of slack and an output of 1,106,267 units this represents 234 tons of slack per annum, which, at a price of 7*s.* 3*d.* per ton, will be worth, say, £85. The steam consumption when running one set excited without load, together with auxiliaries, was 1,420 pounds per hour. With a battery installed, it should be possible to reduce the running hours of the plant at least one and one-half hours a day, or 547.5 hours per annum. The saving will then be 780,000 pounds steam per annum. Allowing for the same evaporation, this gives forty-six tons of slack per annum, worth £17. The total gain in fuel is therefore 280 tons per annum of a value of £102. It may be noted in passing that the value would be double that amount if the price of coal was 14*s.* 6*d.* instead of 7*s.* 3*d.* If one set of plant is run instead of two there will be a further saving in oil and stores, repairs and wages of attendant, as the cost under these headings does not depend on output so much as on the actual running hours. These may be taken as follows: oil and stores, £35 a year; re-

pairs, £40, and attendance, £25; a total of £100 a year. The payments under a maintenance agreement for a period of years on a battery capable of giving 250 kilowatts at the one-hour rate would be about £150 per annum. The savings shown above in running one set of plant instead of two, total up to £202, so that there is a clear gain in favor of the battery of £52 per annum.

Charges for Supply—The addition of a tramway load to a small existing lighting and power station undoubtedly has a beneficial effect on the costs of the producing department. This is not necessarily due to the tramway load in itself or to an increase in the load-factor of the station, if such occurs, but is the result of the relatively large increase in the output when the tramway is started. The reduction in cost would probably be quite as much if the increased output was for light and power. Without wishing to depreciate the influence that high load-factor has on the question of economical generation, the writer is inclined to think that sufficient importance is not attached to the effect of a large increase in the output. Published records only show the result of tacking on a tramway load to an existing light and power station; it would be interesting to see the result of adding a large power and lighting load to an existing tramway station. Although the combined load-factor conditions would probably be worse, there is no doubt the cost sheet would show useful reductions.

From time to time the writer has had to go carefully into the charges for tramway supply. In order that the matter may be discussed the following particulars relating to an undertaking, together with the method employed of allocating the costs, are given herewith.

The total capacity of the plant installed is 1,760 kilowatts, and the generators are suitable for a direct-current working pressure of 440 to 525 volts. The capital expenditure to the end of March, 1906, was as follows:

Site and buildings	£14,634
Generating plant and accessories	35,587
Mains, meters and public lamps, etc.	34,447
Total	£84,668

	Light and Power.	Tramways.	Total.
Output	763,293	1,106,267	1,869,560
Maximum load	468 kilowatts	676 kilowatts	1,144 kilowatts

The cost sheet for the year ended March last is as follows: coal, £1,642; water and stores, £220; wages, £1,011; repairs, plant, etc., £555; repairs, mains and meters, £390; rates and taxes, £568; management, etc., £1,042; interest and sinking fund on the whole of the capital, £5,254; a total of £10,682. Several of these items will, however, require revision before allocating them as charges against either lighting or tramway supply. The capital expenditure on mains, etc., of £34,447 is exclusively for light and power. This represents a payment for interest and sinking fund of £2,138, which, deducted from £5,254, leaves £3,116. Repairs to mains, meters, etc., at a cost of £390 and £30, included in management expenses for collecting light and power accounts, must also be eliminated from the cost sheet so far as the tramway department is concerned. Rates and taxes, management expenses, etc., depend principally on capital expenditure, so that a reduction from the sum of £1,580 must be made in the proportion that the capital outlay on mains bears to the total capital. This works out at £643, leaving £937 as the charge on account of the generating station and equipment. The total amount to be divided between lighting and tramways is therefore £7,481, made up of works costs, £3,428; rates and management, £937; interest and sinking fund, £3,116.

Dealing first with the costs for rates, management, interest and sinking fund, these charges are due to capital expenditure, and as lighting has demanded 468 kilowatts, and tramways 676 kilowatts, the allocation will be £2,395 to tramways and £1,658 to lighting, etc.

It is impossible to divide up the working costs without taking into consideration the load-factor of the different classes of supply. The term "load-factor" as usually used is the percentage obtained by dividing the actual output by the possible output, assuming the maximum load was used twenty-four hours a day. In the writer's opinion the figure obtained in this way is quite useless as a guide to the economical capabilities of a works. The maximum load invariably occurs during the month of December and is of short duration. It may be quite abnormal on more than one occasion without having any effect whatever on the total capital charges for the year or on the working expenses, yet the load-factor taken from this maximum load is commonly used as being the important factor governing the costs for the whole year. An average of the weekly load-factors would give one a good idea of the conditions under which a station is run if the plant is in regular use for twenty-four hours a day; but where batteries are installed and the steam plant entirely shut down for several hours, it would still be misleading.

To show the difference in the load-factors when worked out by the two methods mentioned above, the values are set out below:

	Tramways. Per Cent.	Lighting. Per Cent.	Combined. Per Cent.
Load-factor	18.6	18.6	18.6
Average weekly load-factor	24.5	26.7	25.3
Maximum " "	29.6	32.8	29.8
Minimum " "	17.6	19.3	20.9
Average weekly plant load-factor	32.0	36.5	32.1
Maximum weekly plant load-factor	38.6	46.1	39.1
Minimum weekly plant load-factor	24.8	32.0	27.0

Assuming that the contention put forward is correct, we have now to divide up the works costs of £3,428 on the basis of a 36.5 per cent plant load-factor for lighting and thirty-two per cent for tramways. The works costs divided by the total output gives an average cost of 0.44*d.* per unit. Plotted out on a load-factor curve it will be found that the difference in cost between a thirty-two and 36.5 per cent load-factor is about four per cent. The cost of the tramway units will therefore be rather less than 0.45*d.*, say, a total of £2,060, and the lighting units slightly more than 0.43*d.*, a total of £1,368. The total cost of the tramway supply is therefore £4,455, equal to 0.966*d.* per unit, made up of works costs £2,060 and rates, management and capital charges, £2,395. The charge made for the tramway supply has been £5,300, at an average price of 1.15*d.* per unit, metered at the switchboard. Deducting the cost from this amount there is a balance of £845 left for depreciation. In some towns the supply department has provided the tramway feeder cables and has consequently to include in the price a sum to cover the capital costs on such expenditure and also repairs. The capital for this work has in this case been found by the tramway department and the maintenance is also carried out at their expense. It may, however, be of interest to state that these charges would add 0.11*d.* per unit to the cost mentioned above, so that the inclusive cost of the energy delivered to the trolley wires has been 1.26*d.* per unit.

Electrical Patents.

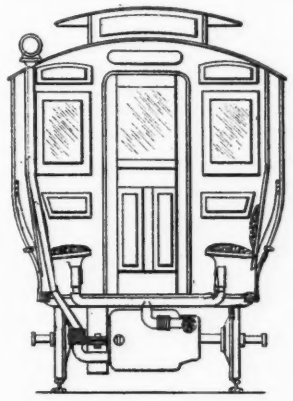
An improved electric igniter has been invented by Henry M. Kolb, Philadelphia, Pa. (825,664, July 10). This invention consists of a new and useful electric igniter which is adapted for use in connection with gas stoves and the like, or may be employed for igniting gases for other purposes. The invention consists of a handle, a tube secured therein and forming part of the electric circuit, a rod within the tube projecting therefrom and

ELECTRIC IGNITER.

forming another part of the electric circuit, a contact device supported by and pivoted upon the tube in electrical contact with the tube and arranged to move transversely of the rod to make contact therewith and insulation between the tube and rod at the outer end of the tube, maintaining their relative positions.

Garrison Babcock, of Chicago, Ill., has obtained letters patent of the United States, No. 824,701, dated July 3, 1906, for an improved multiparty line exchange system, and he has assigned the same to Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The invention relates to multiparty telephone exchange systems, and has for its object improved central exchange apparatus and connections whereby the central operator may more readily establish circuit conditions necessary for such systems. The invention consists in the combination with a central exchange, of telephone lines leading therefrom, a plurality of substations connected with each line, a source of current and circuit-changing mechanism, whereby current impulses are sent into the associated lines to actuate the substation apparatus connected therewith. Means are provided at the exchange for automatically grounding the source of current only at predetermined numbers of current pulsations, whereby the substation apparatus is connected with said source of current and actuated thereby. Keys are provided for sending a current of opposite polarity to restore all the substation apparatus to its normal condition after actuation thereof.

Harold W. Buck, Niagara Falls, N. Y., has obtained a patent (825,298, July 10) for an improved electric car heater, which he has assigned to the General Electric Company. This invention relates to electric railways, and its object is to provide means whereby an electric railway car can be heated by utilizing the energy otherwise lost in heating the motor windings. Heretofore it has been customary to heat an electric railway car by means of resistance coils located under the seats or at any other convenient point in the car. In cold weather the amount of energy required to operate these heaters is frequently as much as fifty per cent of that required to drive the car. The load on the generators is therefore very greatly increased when the heaters are used, and any device which enables a part of this load to be removed is of great practical value. In the operation of an electric motor considerable heat is generated in the motor windings—so much that the problem of keeping the motor cool has engaged the attention of many engineers and inventors. The invention aims to utilize this heat for warming the car and

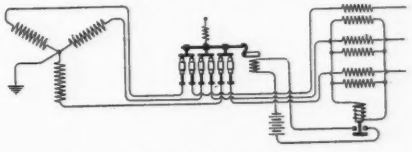


ELECTRIC CAR HEATER.

at the same time prevent the motor from getting overheated. To this end the invention consists in certain devices whereby the heat generated in the motor windings is conveyed into the car, preferably by a current of air, a supply of fresh, cool air being constantly supplied to the motor casing and the heated air conducted away to registers in the car. Means are also provided whereby the hot air can escape into the outside air without entering the car in case the weather is so mild as to make the heating of the car unnecessary.

Wilbur B. Driver, of East Orange, N. J., has obtained letters-patent of the United States (824,103, June 26, 1906) for an improved alloy. The invention consists of a new and useful improvement in alloys or compounds of copper-nickel and manganese which are designed primarily for use as electrical resistance to take the place of materials heretofore used for that purpose, especially German silver, which has for many years been regarded as a standard material for the purpose, but which possesses many disadvantages that are eliminated by using the alloy of this invention. The object is to produce an alloy that shall not only have a high and practically constant resistance, but one that is permanent and stable in its physical and electrical properties. The particular disadvantage of German silver is that after repeated heatings and coolings in service it crystallizes and breaks. This is due to the presence of zinc and is not an infrequent occurrence in any alloy of which zinc forms a considerable part, and for this reason zinc is omitted in the new alloy. "Eighteen per cent German silver," the grade most frequently used, is composed of eighteen to twenty parts nickel, ten to twenty-five parts zinc and fifty-five to seventy-two parts copper. In the improved alloy about the same proportions of copper and of nickel are used, but the zinc is replaced with about five parts of manganese. This makes an alloy consisting of about seventy-five parts copper, twenty parts nickel and five parts manganese. Nickel and manganese each has the effect of increasing the resistance of the alloy, the manganese, however, to a much greater extent than the nickel; but manganese has a tendency to make the alloy unstable, and therefore a considerable amount of nickel—ten per cent or more—is used for the purpose of "fixing" the electrical qualities of the resultant alloy.

Ernest F. W. Alexanderson, Schenectady, N. Y., has obtained a patent (825,286, July 10) for an improved ground detector and cutout, which he has assigned to the General Electric Company. The invention relates to protection against grounds of three-phase systems having a grounded neutral point, and its object is to provide protective means for detecting grounds or cutting out grounded lines or both, which is more sensitive and reliable than the devices heretofore employed. The invention consists of a three-phase system with grounded neutral point, parallel lines, relays at each end of each line, connections for supplying to each relay a current proportional to the algebraic sum of the currents in the three phases at each end of the line, means controlled by each relay for opening the circuit of the line at that end, and means for retarding the movement of the relays.



GROUND-DETECTOR AND CUTOUT.

Reviews of Current Engineering and Scientific Literature.

"Roaring" or "Corrugated" Steel Rails.

G. Moyle, engineer-in-chief of the Eastern Bengal State Railway, is the author of a technical paper on the above subject issued by the Indian government. "Roaring" may be defined as the noise caused by the development of furrows across the running head of a rail, usually oblique to its length, the tops of the furrows being very hard and the bottoms soft. Such rails are also described as "corrugated." They do not in the least resemble pitted rails. The common objection to these rails is that they occasion a deafening noise when trains are passing over them which causes great discomfort to passengers. To give an impression of how objectionable the noise is it may be stated that two persons can not possibly converse even by shouting when running over a continuous section of these rails. The engineers of Indian railways have had "roaring" rails under observation for the past eight years, but up to the present time no definite conclusion has been formed as to the real cause of the phenomenon, and no manufacturers' specifications have been drawn with a view to producing a metal likely to be exempt from its development. The paper is written for the purpose of bringing the phenomenon to the notice of rail experts, with the hope that a remedy for it may be discovered. The mean pitch of the corrugations has been found to be 0.74 inch, and the mean depth, 0.0035 inch. Both double-headed and flat-footed rails develop this phenomenon. It is not confined to any particular section. It is developed in rails rolled by various manufacturers, and develops with equal facility on banks or cuttings, grades or levels, straights or curves. It appears to be found more generally in extremely damp climates, especially when the atmosphere contains salt brought from the sea. It develops most rapidly where brakes are frequently used, but it is not necessarily produced by brake action, since it exists abundantly in parts of tracks where brakes are never put down. "Roarers" are almost invariably developed where the track is packed and boxed with brick or burned-clay ballast and on open-girder bridges, but they are scarcely ever found where the ballast is stone, and never where the track is packed and boxed with earth. On brick-ballasted road they can be made smooth if the brick boxing is removed and replaced by earth. The trains then wear the rail smooth. "Roaring" has only been found in steel rails and never in an iron rail. The ridges of a "roaring" rail resist a file, but the metal in the hollows is removed quite easily. Many explanations have been suggested by various engineers as to the cause of "roaring." An idea of the extent to which this phenomenon can develop under favorable conditions has been shown by an inspection of a section of single track on the Eastern Bengal State Railway between Dacca and Mymensingh, twelve and one-half miles long. All the rails were carefully counted, and it was found that eighty-nine per cent were "roarers." The traffic in this section is light, the speed low and the track maintenance excellent. No continuous brake is or ever has been used. On the other hand, the section examined is brick-ballasted, the climate is extremely moist, the rainfall excessive and the atmosphere is said to be charged with salts.—*Abstracted from the Mechanical Engineer (London), July 7.*

International Science.

Within the last century many problems have become urgent which could not be solved without some international agreement, and special organizations have come into life which have rendered a service, the importance of which can not be exaggerated. In a discourse delivered at the Royal Institution, London, May 18, Professor Arthur Schuster holds that international combination has become so necessary, and organizations have in consequence increased to such an extent, that they begin to overlap, and there has been some danger of mutual interference. Fear has also been expressed that any attempt to advance knowledge by an organized combination of workers might discourage private efforts, and therefore do mischief rather than good. Three types of international organizations may be distinguished. The first aims merely at collecting information, the second is intended to fix international units or to initiate agreements on matters in which uniformity is desirable, while by the third type of organization a more direct advance of knowledge is aimed at and research is carried out according to a combined scheme. The best example of an organization formed for the purpose of collecting information is furnished by the undertaking initiated by the Royal Society, having for its object the systematic cataloguing of scientific literature, both according to subjects and authors. Twenty-nine countries are actively participating in this work by furnishing slips containing the entries which form the basis of the catalogue. A still larger number of countries assist by subscribing to the annual volumes. The total number of slips received up to March, 1906, is about 700,000. The governing body of the catalogue is an international council composed of one representative from each of the countries taking part in the scheme. Passing on to an undertaking of a very different kind, but which must be included in the class which primarily aims at cataloguing, is the accurate determination of the positions of the stars for a particular period. This is a work which must precede all exact investigations of their proper motions, hence it constitutes a fundamental problem of astronomy. The multitude of stars seen on a bright night is bewildering to the casual observer, but when an actual count is made it is found that their number is really moderate, and it is doubtful if more than 2,000 stars have ever been visible to the naked eye at the same time. The international star catalogue, which is at present being constructed, owes its origin mainly to the hard work of Mouchez. The programme of work was determined upon at an international conference which met at Paris in the year 1887. Eighteen observatories were to take part in the work. Each observatory had a certain region of the sky assigned to it and undertook to cover this region four times, twice with plates of short exposure, twice with plates of long exposure, and to measure all the stars appearing on the short-exposure photographs. The long exposures were intended for reproduction in the form of charts. As there are about 400 stars on each plate, and it takes about 600 plates to cover the share of one observatory once, this means that each observatory has to measure nearly half a million star places, and that the complete catalogue will give the positions of nearly 4,500,000 stars. This includes all stars down to the eleventh magnitude. It is calculated that the series of maps, which it is hoped will be completed, will form a pile of paper thirty feet high, weighing about two tons. Pass-

ing on to those undertakings which are intended to fix standards of measurement or to establish a general agreement on matters in which uniformity is desirable, the foremost place in this division must be given to the Bureau Internationale des Poyds et Mesures, which was established in the year 1873 at Sevres, near Paris. This bureau was the outcome of an international commission constituted in 1869, which had for its object the scientific construction of a series of international metric standards. The work carried out at Sevres is not confined to the reproduction of metric standards, but measurements of precision in various directions have been made with conspicuous success. Scientific thermometry owes much to the international bureau, and, in some respects, it may be said that exact thermometry was created there. Professor Michelson's work, in which the length of the metre was compared directly with the length of a wave of red light, is another classical investigation carried on in the laboratories of the international bureau. There are other deficiencies of uniformity which perhaps appear trifling, but which lead to the waste of a good deal of time. Such, for instance, is the position of the index in scientific books. It is time we turned to the more serious aspect of those international associations which directly aim at an advance of knowledge. It is worth while investigating the extent of the direct knowledge of a third dimension. The question of measuring the size of the earth, geodetic work and other researches are all very prominent examples of the need for and value of international investigation.—*Abstracted from Nature (London), July 5.*

Interference in Wireless Telegraphy.

Professor R. A. Fessenden divides tests on cutting out interference into two classes —pseudo tests and tests properly so called. The pseudo test is a test made under conditions which have no bearing on the practical question and in which practical working obstacles have been carefully eliminated. A test properly so called is one made under practical conditions. He shows the difference between a pseudo test and a real test, and concludes that the pseudo tests have no bearing upon the real question as to whether wireless telegraph stations can work selectively. The statement has been frequently made that disturbing stations can be cut out by tuning. These statements were at first accepted by the general public and also by many engineers, but when the fact became known that interference still caused trouble the previous attitude of unquestioning belief changed to one of complete incredulity. When a certain company requested of the United States Navy Department in 1902 an opportunity to show that interference could be cut out it was informed by the department that nearly every other company was claiming the same thing and that in every case where the matter had been investigated it had been found that interference could not be cut out, and that the department attached no importance to statements of that kind. While Professor Fessenden considers that the action taken by various governments in regard to wireless telegraph work has been of a most oppressive and unfair character, at the same time he is free to admit that the wireless companies, considered as a whole, have only themselves to blame for the situation. Several years ago he pointed out that selectivity can never be accomplished by tuning. The amplitude of the oscillations in the resonant circuit can not increase indefinitely, for when the point is reached at which the losses in the resonant circuit become equal to the energy received by the resonant circuit, no further increase is possible. Assume that the resonant receiving circuit has an efficiency of ninety-nine per cent—that is, it wastes only one per cent of the energy which it stores up. This, it will be admitted, is a pretty high efficiency. Then, in this case, the strength of the signals at the resonant point will be one hundred times the strength away from the resonant point. He states that even with a resonant receiving circuit having an efficiency of ninety-nine per cent, an interfering station within ten per cent of the distance of the sending station will prevent the receipt of messages. This is approximately what is found in practice. In fact, in the United States Navy tests it was found that the interfering station prevented the reception of messages by all systems tested which depended upon tuning for selectivity, when within twenty per cent of the distance of the sending station. Ten or fifteen years ago, when the question of multiplex working by alternating currents came up, the question of loose-coupled circuits attracted a good deal of discussion. At first loosely coupled circuits were quite generally used in experiments on electrical oscillations, but those familiar with the laws of optics soon saw that, in most cases, it was advisable to use tightly coupled circuits. The electrical explanation of the phenomena of coupled circuits is comparatively simple. Let A be an oscillating circuit having a natural frequency, X, and let the circuit, B, whose natural period is also X, be brought into inductive relation with the circuit, A, so that B forms a secondary of which A is the primary. From the usual formulae it can be shown that the currents in the two circuits are not in the same phase. This being the case, the current in each circuit can be split up into two components, two of these components being in opposite phase to each other, and the other components being in the same phase. The two circuits, A and B, will therefore have two values of their coefficients of self-induction, according as we consider components in phase with each other or opposed to each other. There will, in general, be two natural frequencies for each of the circuits. There are two cases in which the two circuits have but a single frequency. The first case is when the coupling is infinitely tight, when there is no magnetic leakage between circuit A and circuit B; and the second case is where the coupling is infinitely loose. Unless the coupling between the two circuits is either infinitely tight or infinitely loose there will always be two oscillations of different frequencies. The advocates of loose couple have grasped the fact that by reducing the strength of the coupling between the two circuits, the frequencies of the two oscillations may be made to approach each other; but they have not grasped the fact that as the strength of the coupling is weakened and the frequencies made to approach each other, the transference of energy diminishes in a still greater degree, and that when finally the two frequencies are made to coincide, the primary circuit transfers no energy to the secondary circuit. Another vital point which the advocates of loose coupling have not grasped is the fact that even with a very small coefficient of couple, the difference between the frequencies will still be much too great for practical work. With the present methods of cutting out interference a difference of frequency of one and one-half per cent is a large difference, and in the author's work between Scotland and Massachusetts a difference of one-quarter per cent in frequency was sufficient to cut down the intensity of the signals more than twenty times. If the circuit were coupled so loosely that the maxima of both frequencies differed by less than one-quarter per cent, the amount of energy transmitted or received would be very little indeed.—*Abstracted from the Electrical Review (London), July 6.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

THE COMMERCIAL DEVELOPMENT OF ELECTRICAL UNDERTAKINGS.

At the recent meeting in London of the Incorporated Municipal Electrical Association, a paper on "The Commercial Development of Electrical Undertakings" was presented by H. Collings Bishop, borough electrical engineer and tramways manager, Newport (Monmouth), England, from which the following abstract is taken:

Advertising—The author considers the first step is to compile a good "brochure," which will put before the public, in a simple way without technicalities, the advantages to be derived from the use of electrical energy. Newport has been especially successful in this respect, having published, a few months ago, a book which has met with universal approval. It contains from seventy to eighty pages of reading matter. A number of pages are taken up with views of various premises belonging to consumers of electricity in the district. The brochure was compiled by the secretary of the electricity department, and is partly original and partly derived from information given by engineers of various electrical stations. The revenue from advertisements paid all publication expenses, and enabled the department to distribute some thousands of free copies to likely consumers. Another good form of advertising, in the author's opinion, is to send out picture postcards containing photographs of new additions to the consumer's register. Yet another means of advertising, and one that serves a canvasser as an introduction, is a series of letter circulars, dealing with the supply of energy for power, lighting, heating and cooking.

Canvassing—For this purpose a man must be found who, if possible, is well known in the town, and who possesses a thorough knowledge of his subject. He should be a good talker, and should be one who does not easily accept a rebuff. His mode of operation might be as follows: to make himself well acquainted with all the details of the consumption of current and the type and size of installations of all the most important consumers; to be thoroughly conversant with the relative costs of current used by the different classes of consumers; to be able to give the cost of current per hour of the various forms of illuminants, and to compare the other ways of obtaining power with that of electricity. A canvasser should have sufficient technical training to be able to give a prospective consumer some idea of his own requirements.

Exhibitions—These the author has found to be of the utmost value in promoting the development of an electrical undertaking. In the autumn of last year the local gas company at Newport, which is a keen rival of the electricity department, held what they called a gas exhibition. This, in effect, appeared to be a demonstration of inverted and intensified incandescent gas light and cooking stoves, accompanied by an almost unbearable heat, which amply demonstrated the heating power of gas. This heat was to some extent lessened by the introduction of electric fans. Shortly after the gas exhibition, a resolution was passed to hold an exhibition of electrical apparatus especially suited to the requirements of consumers of current derived from the central station. The committee obtained the use of the largest hall in the town, in which they were able to erect nineteen stands. These were allotted to the various contractors of the district, several being retained for the corporation's own exhibits. In view of the decision of the Manufacturers' Association regarding country exhibitions, the author was at first rather afraid of the response he would receive when asking for the loan of apparatus; he, however, found the majority of the manufacturers extremely willing to help. In only a few cases was a refusal given, and in most cases the only condition imposed was that the carriage of the goods sent should be paid by the committee. The exhibition was opened in January, a small string band during the afternoon and evening being provided as an extra attraction to visitors. There was also a tea room, in which all the tea and coffee was made in electrically heated vessels. The exhibits mainly consisted of electrical fittings, various types of radiators and convectors, and many different forms of incandescent lamps, arc lamps, flame lamps, etc. There were also decorative devices for tables and shop windows.

The exhibition lasted for a week, and the building was packed during the whole time it was open. No charge was made for admission. The total cost of the exhibition, after deducting the proceeds from the letting of spaces, and the small sum derived from the sale of current, was under £250. The effect of the exhibition was immediately felt in a large increase in the connections to the mains. The author can conceive no better means for the development of an electrical undertaking than such an exhibition.

Charges—As one of those who some years ago adopted the Brighton system of charging, the author has, after several years' trial, come to the conclusion that (equitable system as it is) it is not one that tends to further the development of an electrical undertaking. The system is difficult to explain, and one that, even if understood, is not appreciated. A charge by a sliding-scale rate seems to the author to be the correct solution of the problem, and the load-factor of the various classes of consumers should be taken into consideration in the arrangement of this scale.

As regards the charges for power, the author would make a maximum rate of three and one-half pence per unit for current used during the few hours of maximum demand, and one penny per unit during the whole of the rest of the day or night. This system has been used with conspicuous success in Newport; consumers of a large amount of current who have a load-factor of not less than twenty per cent should be charged eight pence per unit. Consumers of power should be given a specially low lighting rate, so arranged that it becomes possible for the largest consumers to have a uniform rate for both lighting and power. With reference to the charges for heating, the author considers the rate of one penny per unit the most satisfactory.

The question of the supply of wiring and fittings on the hire or hire-purchase system is one that is fraught with a good many difficulties, owing to the fact that it is often hard to make a mutual agreement with both tenant and landlord; such an agreement being very necessary in order to facilitate the removal of fittings, should the hiring agreement be cancelled. It is also very important that some system of wiring, that is unobtrusive and at the same time easily removed, should be adopted for use where there is a hiring agreement, and the author hopes some new suggestions on this point will be forthcoming.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Horizontal Type Direct-Current Curtis Steam Turbine Generators.

The accompanying illustrations show several views of the horizontal-type direct-current Curtis steam turbine generators placed on the market by the General Electric Company, Schenectady, N. Y. These units are now extensively used in commercial service, and are built in sizes of fifteen kilowatts, twenty kilowatts, twenty-five kilowatts, seventy-five kilowatts, 150 kilowatts and 300 kilowatts capacity, and can be arranged either for non-condensing or condensing operation. The fifteen, twenty and twenty-five-kilowatt sizes are equipped with two bearings and have a single-piece shaft, and the larger sizes with four bearings and a two-piece shaft connected by means of a flexible coupling. Fig. 1 shows a turbine generator of 150 kilowatts capacity. The speed is 2,000 revolutions per minute, the voltage 125 or 250, the length sixteen feet and the weight 25,500 pounds. In the illustration the turbine is shown without the sheet-iron lagging, to demonstrate the construction of the wheel casing. This turbine may also be connected to two seventy-five-kilowatt generators for three-wire operation.

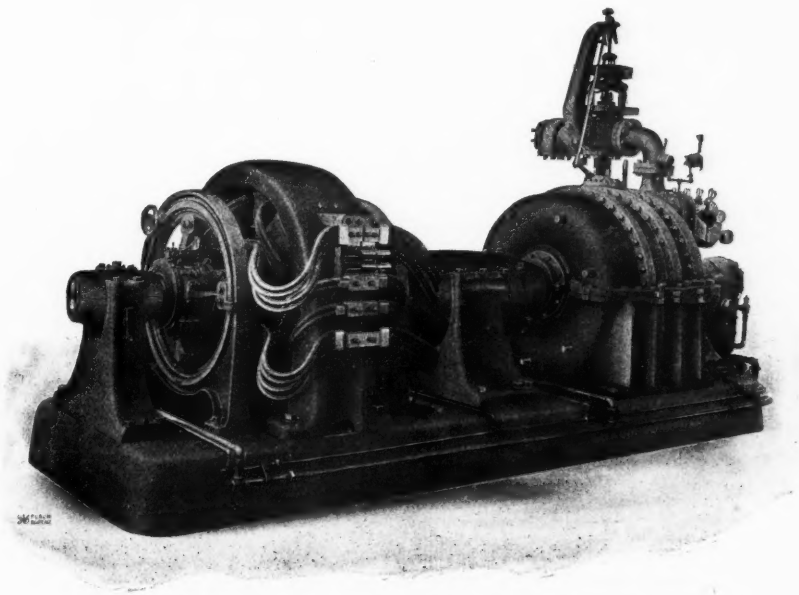


FIG. 1.—150-KILOWATT, HORIZONTAL TYPE CURTIS TURBINE-GENERATOR.

The generators are of the most improved type and embody special features particularly adapting them for turbine units. The turbines built for condensing operation will have their full rated capacity when operating non-condensing. As there are no exhaust valves on the turbines, and as the exhaust passages are large, a high vacuum can readily be maintained. As no cylinder or other internal oil is used, the exhaust steam is free from oil.

FIG. 2.—TURBINE NOZZLE.

Oil is supplied to the bearings at a slight pressure by means of a pump driven from the main shaft, supplemented by oil rings, or, in the smaller sizes, by oil rings alone.

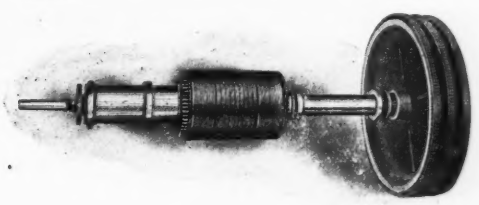


FIG. 3.—TWENTY-FIVE KILOWATT TURBINE WHEEL AND ARMATURE.

The speed is controlled by means of a centrifugal governor mounted directly on the end of the turbine shaft. This governor, through a suitable valve arrangement, controls the supply of steam entering the turbine, the speed being maintained practically constant independent of the amount of power supplied by the generator. In addition to the regular governing mechanism, an emergency governor is supplied, which immediately shuts off

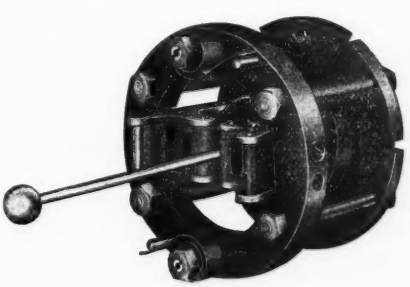


FIG. 4.—GOVERNOR.

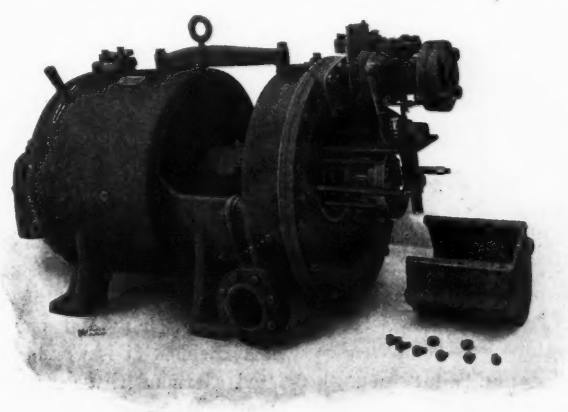


FIG. 5.—TWENTY-FIVE KILOWATT, HORIZONTAL TYPE CURTIS TURBINE-GENERATOR.

the steam supply if, through some abnormal condition, the speed should rise some predetermined amount above normal, preventing the machine from attaining a dangerous speed.

Foundations of but moderate size are required, due to the light weight and small size of the turbines and the absence of reciprocating parts. The smaller sizes may be arranged to operate at any steam pressure above eighty pounds, and the larger sizes at any pressure above 100 pounds. Superheated steam may be used, superheated to about 200 degrees Fahrenheit.

Fig. 2 shows the turbine nozzle, Fig. 3 a twenty-five-kilowatt turbine wheel and armature assembled on the shaft, Fig. 4 the governor, and Fig. 5 a twenty-five-kilowatt turbine generator for all classes of interior service. This machine has a speed of 3,600 revolutions per minute, a voltage of 125 or 250, a length of six feet and weighs 3,600 pounds.

The Electrical Equipment of the Indiana Steel Company, Gary, Ind.

The new Gary (Ind.) steel plant of the Indiana Steel Company when completed will be one of the largest adaptations of motor-driven apparatus in the country. It is estimated that the plant will be able to handle substantially 5,000,000 tons of ore a year, producing annually approximately 2,500,000 tons of steel. There will be sixteen blast-furnaces of 450 tons daily capacity each and eighty-four open-hearth furnaces each with a capacity of sixty tons. The necessary electrical generating equipment capable of handling such an output will have an initial capacity of 18,000 kilowatts. The plant will be so designed that extensions may be added indefinitely. Of the initial equipment, 14,000 kilowatts will be in 2,000-kilowatt, twenty-five-cycle, 2,300-volt units, and 4,000 kilowatts in 2,000-kilowatt, 250-volt, direct-current units. These generators have been ordered from the Allis-Chalmers Company, Milwaukee, Wis. The generators will be driven by Allis-Chalmers horizontal twin tandem gas engines.

The power-house building for the present is to be approximately 700 feet long, with a span in the main building of eighty-eight feet. An eighteen-foot extension under the same roof through the entire length of the structure has been planned in order to provide room for high-tension switches. The power-house will be located immediately adjacent to the blast-furnace blowing engine houses and between the blast-furnaces and the open-hearth furnaces.

A New Form of Flashing Sign.

The accompanying illustration shows the "Flash-I-Do" advertising sign, placed upon the market by Lindstrom, Smith Company, 59 Dearborn street, Chicago,

FLASHING SIGN.

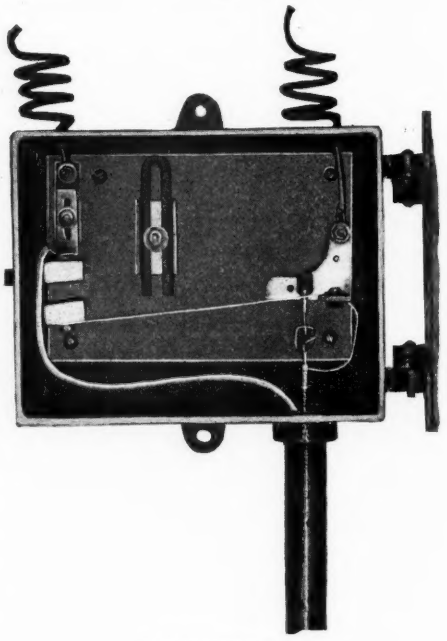
Ill. This is a double sign having a glass face on each side. It is equipped with a swivel socket, enabling the user to place it in any position. The signs are made of iron plate finely enameled white on the inside and black on the outside. They are provided with twenty-four five-sixteenths-inch holes around the edge, which serve to ventilate the sign. The swivel plug, which is especially made for these signs, is three and one-half inches long, and is made of porcelain with a brass cap on the outside to make connection with the socket. The plug has a corrugated rim around the top which makes it turn easily. There is a metal tube fastened to the body of the sign, and in this tube the swivel socket is placed in such a way that the sign never needs to be turned in fastening it to a socket. There is a socket fastened on the tube on the inside for holding the lamp. This is placed so that the lamp will always be in the centre of the sign.

The automatic thermostat or flasher is mounted on a porcelain base five and one-half inches long and one and one-half inches wide. It is wound with fine insulated German silver wire, insulated to stand any current up to 250 volts. The contact points are made of pure platinum and are fitted with an adjusting screw, by means of which adjustment can be made so that the thermostat will flash either fast or slow or make the lamp burn steady.

The frame holding the glass in place is made of brass, highly polished and lacquered. It is fitted with three brass thumbscrews on the side for maintaining the glass in position. The sign is furnished with ground glass plates and the letters making up the sign may either be painted or gummed on the glass.

The "Hylo" Flasher.

The accompanying illustration shows a new form of flasher which the Phelps Company, Detroit, Mich., has placed upon the market. This flasher is designated as the "Skedoodle J." The operation of the flasher is easily understood from the illustration. In the "Skedoodle J" the manufacturer utilizes the sticking of the magnet to ensure a very clean make and break. The current normally passes from the terminal stud on the left through the carbon contacts across the spring of the flasher and out through the terminal stud



"SKEDOODLE J."

at the right-hand side, which completes the main lighting circuit. A shunt-circuit will be noticed passing around the lower carbon block and including a resistance winding about a rod, the resistance winding terminating at the stud at the right-hand side of the flasher. The permanent magnet tends to draw the lower carbon block into contact with the upper block. The tension on the wire rod, however, holds the blocks separated until the current passing through the resistance wire heats it so that, upon expansion taking place, the carbon blocks are pulled together and held tightly closed by the sticking effect of the magnet until the contraction of the rod is sufficient to pull the carbon blocks apart with a clear break. The illustration shows the single-pole

type of "Skedoodle J." This type has been built to carry as high a current as thirty-five amperes experimentally, and twenty-five amperes for a steady load. This single-pole type, however, will probably be standardized at six amperes' capacity, and a similar design with a double-pole construction will be placed upon the market for twenty-five amperes' capacity.

Allis-Chalmers Company and the Manufacture of Christensen Air-Brakes.

Since the announcement, made some weeks ago by the Allis-Chalmers Company, Milwaukee, Wis., of the acquisition of exclusive rights to build and sell Christensen air-brakes, the company has been busily organizing its new department for the extensive manufacture of this well-known device.

J. H. Denton, who was general superintendent of the National Brake and Electric Company, has been engaged to act as manager of the new air-brake department, and he will be surrounded by a staff of men who have been especially trained in this branch of manufacture. Shop facilities are being provided as rapidly as possible, and it is expected that shipments may be made from stock within seventy-five days from date. The entire second floor of the north shop, "Reliance" works, Milwaukee, now occupied by the company's general offices, will be devoted to the manufacturing and assembling of air-brake equipments, following the removal of the offices to the West Allis works.

The following men, all of whom are thoroughly conversant with air-brake practice, are now associated with the Allis-Chalmers organization: F. C. Randall, formerly vice-president and general manager of the National Electric Company, for the past year has been manager of the New York district office of the Allis-Chalmers Company, and, owing to his intimate acquaintance with the manufacture and application of air-brakes, is exceptionally well qualified to advise with traction men on this subject; W. W. Power, formerly manager of the National Brake and Electric Company's Philadelphia office, was recently appointed manager of the Philadelphia district office of the Allis-Chalmers Company; George C. Voigt, formerly of the National Electric Company, has lately identified himself with the Allis-Chalmers Company and will have charge of air-brakes sales in western territory, and George C. Dresser, until recently with the National Brake and Electric Company, is to be attached to the Allis-Chalmers Company's New York office, as a special representative of the air-brake department.

American-Ball Engines and Generators.

One of the principal advantages of the American-Ball duplex compound engines is their compactness. This engine, it is stated, occupies no more floor space than a simple engine of less power. The high and low-pressure cylinders are cast together, one directly below the other. One cross-head carries both piston rods, while a single continuous valve of improved design controls the emission and exhaust in both cylinders. The emission and exhaust are simultaneous in both cylinders, securing an even distribution of the work between the two pistons.

One of the chief characteristics of this engine is the inertia governor, which maintains a speed regulation within one-tenth of one per cent from no load to full load suddenly applied. A continuous oiling system is provided, which, while not depending upon the splash principle, is said to be positive in its action.

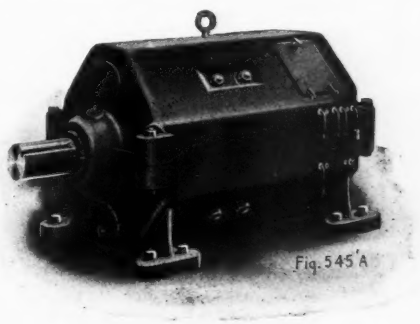
The manufacturer of these engines, the American Engine Company, Bound Brook, N. J., is specializing in the construction of complete generating sets. The American-Ball dynamos conform with the most approved principles of modern practice. Special attention has been devoted to the matter of armature ventilation. Heating is kept as low as possible by a single large air-duct dividing the armature transversely into halves. This acts as a centrifugal blower, drawing a volume of fresh air through the armature and giving thorough ventilation to the machine. The armature coils are formed of solid bar copper, wound with cotton and thoroughly insulated, allowing a large cross-section of copper.

Among recent sales may be mentioned the following: two eighty-horse-power duplex compound engines for the De Lamar Copper Refining Company, Perth Amboy, N. J.; three duplex compound engines for the E. I. du Pont Company, Wilmington, Del.; two 200-kilowatt engine-type generators to be water-wheel-driven, for the W. D. Boyce Paper Mills Company, Marseilles, Ill.

Rolling Mill Motors.

The accompanying illustration shows a new line of form "W" rolling-mill motors placed upon the market by the Crocker-Wheeler Company, Ampere, N. J. The form "W" motor is built for outputs of twenty-five, thirty, seventy-five and 100 horse-power. The parts are simple and heavy, and the strength of the parts, the manufacturer announces, corresponds approximately to the parts of ordinary motors of about twice the rated capacity of these machines.

The bearings are completely enclosed, the ends of the bearings being concealed, so that no particles of dust can enter. The motor can be completely disassembled, however, by lifting off the top half after removing four external bolts.



FORM "W" ROLLING-MILL MOTOR.

The armature is so designed and proportioned with reference to the field that the motors operate in both directions under ordinary overloads without sparking. The motors are insulated with fireproof material and can be operated in the hottest places.

The field frame is of steel, octagonal in shape, with four poles, and is divided horizontally, the halves being held by four heavy bolts on the outside. In the twenty-five and fifty-horse-power sizes removing the upper half removes also all of the brush rigging which is connected to the top half of the frame. The connections are all made outside of the shells of the machines, so as to be plainly visible and easily handled. The machines are jig made and therefore interchangeable. The frame is of the enclosed type with hand-hole covers suitably placed on the front and rear ends for inspecting the interior.

The pole shoes are built up of steel laminations and are bolted to the poles by bolts having square heads sunk in pockets on the face of the pole shoes, and with nuts on the outside of the field frame. Each foot is drilled for two heavy hold-

ing-down bolts which will retain the motor securely on its foundations.

The commutator is constructed in the usual way and insulated with the best mica. The clamping bolts are accessible from the front of the commutator, facilitating its removal.

The shafts are of forged steel turned and ground to exact dimensions. They have extensions on both ends, so that the pinion may be placed on either end and a brake on the opposite end. In case the shaft is damaged it can be removed without disconnecting the windings from the commutator, as the commutator is keyed to a sleeve extension of the flange forming one end of the armature core. The armature windings are simple and substantial, each coil consisting of a single turn without joint except where soldered to the commutator bar. The armature conductors are made of flat strip copper separated from each other by asbestos. The coils are placed below the surface of the core and held in place by wedges. No band wires are used on the armature core, except one at each end outside of the core to hold down the coil ends below the surface of the core.

The brushes are carried in cast bronze boxes clamped to large square steel studs. The brushes fit accurately in the boxes and slide in machined ways, and are held against the commutator by curved fingers actuated by coiled springs.

The motors are wound either series or compound.

The Electric Locomotives for the New York Central Lines.

Last October the first half of the 50,000-mile endurance run of the first high-speed electric locomotive, No. 6,000, built jointly by the General Electric Company and the American Locomotive Works, was completed on the test tracks of the New York Central lines at Schenectady, N. Y. On June 12 this locomotive completed the second half of this exhaustive service test. The maintenance expense per mile for the complete 50,000-mile run amounted to $0.0126. This figure includes all maintenance expense on motors, brake shoes, tires, inspection and other miscellaneous items. Moreover, the operating conditions were much more severe than those to which the thirty-five locomotives which have been ordered will be subjected. The test locomotive hauled a train averaging from 200 to 400 tons over a six-mile track, and high-speed running under these conditions involved higher braking and accelerating duty than in regular operating service.

The accompanying illustration shows eight of the thirty-five 100-ton, 2,200-horse-power electric locomotives which have been built for the New York Central lines, following the same design as No. 6,000, which has made such a satisfactory record. In all fourteen machines are now building. Of the eight locomotives shown, Nos. 3,401 and 3,402 have been shipped to New York. These locomotives have been tried out by the operating department of the New York Central Railroad and the test, it is understood, was thoroughly successful. The trials were made on a mile and a half of track at Kingsbridge. The remaining locomotives are well under way at the shops of the General Electric Company and the American Locomotive Works, and it is expected that the whole number, thirty-five, will be ready for service early in October.

Eight of the 100-Ton, 2,200 Horse-Power Electric Locomotives Built for the New York Central & Hudson River Railroad.

Gas-Blowing Engine Plant for the Indiana Steel Company.

The Westinghouse Machine Company, East Pittsburg, Pa., has secured a contract for eight large gas-driven blowing engines to be installed in the plant of the Indiana Steel Company at Gary, Ind. The machines comprised in this initial order will be uniform in size and capacity. Each gas engine as an electric unit will have a rated capacity on blast-furnace gas of nearly 3,000 horse-power, corresponding to a rating of 4,000 horse-power on natural gas. The unit will be arranged in twin-tandem fashion, each side consisting of two double-acting gas cylinders and one blowing cylinder in the opposed or *vis-a-vis* arrangement. The power cylinders are forty-two inches and the air cylinders sixty-eight inches in diameter, with a common stroke of fifty-four inches, the unit running at a maximum speed of seventy-five revolutions per minute for blowing and eighty-four revolutions per minute for electric work. The capacity of air delivery at this speed will be 33,000 cubic feet of free air per minute at eighteen pounds pressure, with a maximum pressure delivery of thirty pounds per square inch.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TACOMA GAS AND ELECTRIC COMPANY—The Tacoma Gas and Electric Company, Tacoma, Wash., has been sold to Deane & Company, of Grand Rapids, Mich., the price paid being approximately $1,000,000.

WESTCHESTER INTERESTS MERGE—A certificate of incorporation has been filed at Hartford, Ct., for the Northern Westchester Securities Company, of Bridgeport, Ct. The capital given is $2,400,000. The incorporators are: F. A. Stratton, Mount Vernon, N. Y.; Louis B. Grant, Brooklyn, N. Y., and Charles H. Werner, New York city. It is said that the new company is really a merger of the gas and electric lighting companies and trolley lines in northern Westchester and eastern Connecticut, under the management of F. A. Stratton, formerly president of the Westchester Lighting Company.

MOHAWK VALLEY COMPANY INCREASES ITS CAPITAL STOCK—The Mohawk Valley Company, Utica, N. Y., has filed a certificate increasing its capital stock from $10,000,000 to $20,000,000. The papers show that the company has issued the full amount of the $10,000,000 capital, and that it is held by the New York Central & Hudson River Railroad Company and Horace E. Andrews, the Central company holding $6,000,000, and Mr. Andrews $4,000,000. The Mohawk Valley Company is the operating company of the trolley lines which have been purchased in recent years by the New York Central, including the Utica & Mohawk Valley Railroad, the Syracuse Rapid Transit Company and the trolley lines in Rochester, N. Y.

TO BUILD NEW ELECTRIC LINE—The Fort Dodge, Des Moines & Southern Railroad Company has secured the money necessary to connect Fort Dodge and Des Moines by an electric line. A mortgage has been filed with the Old Colony Trust Company for bonds to the amount of $12,150,000 for the immediate construction of the line to connect with the Newton & Northwestern and the Ames & College Railroad. The trustee provides also for the issuance of $300,000 more bonds to be used in the purchase of real estate and $750,000 additional to be used in the purchase of coal lands. There has also been filed the transfer of the Northwestern Construction Company to the Fort Dodge, Des Moines & Southern. Homer Loring, of Des Moines, Iowa, signs the papers for the electric line.

PUEBLA PUBLIC UTILITIES PURCHASED—The Mexican Light and Power Company, Limited, has completed the purchase of the Puebla (Mexico) Tramway, Light and Power Company, which includes the electric light company and the urban tramways at Puebla. The company has also completed the purchase of the Tuxipango water power of the Rio Blanco, which is located just south of Orizaba, and which was owned by Oscar and Thomas Braniff. The Mexican Light and Power Company, Limited, intends to develop 30,000 horse-power from this river and bring it to Puebla, making the city independent of power supply from Mexico City. The work that the company will do in the matter of the electrification of the tramways, the reconstruction of the plant, and the development of the water power will mean the expenditure of about $6,000,000.

THE CINCINNATI GAS AND ELECTRIC COMPANY—Efforts are being made to obtain underwriting to the extent of $5,000,000 to carry out a plan of financing the acquisition of the Cincinnati Gas and Electric Company, Cincinnati, Ohio. Archibald S. White, formerly president of the National Salt Company, has acquired an option and lease on the Cincinnati Gas and Electric Company. He proposes to sell it to a projected corporation, to be known as the Union Gas and Electric Company, which will have a capital of $20,000,000, half of which is six per cent preferred stock. The balance is common stock. He has made an agreement with A. B. Leach & Company, George W. Young and Oscar L. Gubelman, who are the syndicate managers. The underwriting syndicate will buy $5,000,000 of the preferred stock of the Union Gas and Electric Company. To each subscriber for five shares of preferred stock at par, two shares of common stock will be given as a bonus. According to the terms of the agreement the syndicate managers may borrow, on behalf of the underwriters, from one or more trust companies funds not to exceed the amount of the unpaid subscriptions of the underwriters. It is stipulated that the agreement shall not become binding until at least $3,000,000 of preferred stock shall have been subscribed. The agreement contains the information that the Union Gas and Electric Company proposes to guarantee, as a result of a lease of the Cincinnati Gas property, four and one-half per cent on the outstanding stock during the first two years, four and three-quarters per cent during the next two years, and five per cent for the remainder of the lease. The lease has been acquired for ninety-nine years. The contract made by White also provides that $3,000,000 shall be deposited with trustees as security for the payment of the rental, and that within the first five years of the term $2,000,000 shall be expended in extensions and additions to the property.

POWER PERMITS GRANTED—Under an act to protect Niagara falls, Secretary Taft has granted these temporary permits to take water: Niagara Falls Power Company, 8,600 cubic feet per second; Niagara Power Company, 4,000 cubic feet per second; Lockport Hydraulic Company, 500 cubic feet from the Erie canal, and 333 cubic feet from the lower level of the Erie canal at Lockport. The Niagara, Lockport & Ontario Power Company is granted permission to receive into the United States electric current equivalent to 25,000 horse-power daily from the Ontario Power Company, of Niagara Falls, Ontario; and the Niagara Falls Power Company not to exceed 25,000 horse-power electrical current daily from the Canadian Niagara Power Company. These permits are the only ones granted for the taking of electricity generated in Canada into the United States. The secretary of war states that it will be necessary to make a thorough investigation before granting permanent permits for such transmission.

OBITUARY NOTICES.

MR. RUSSELL SAGE, the well-known capitalist, died at his country home at Lawrence, L. I., on Sunday, July 22. Mr. Sage was born at Verona, N. Y., August 4, 1816. He began his career as an errand boy in his brother's grocery store at Troy, N. Y., where he advanced very rapidly, becoming a wholesale grocer in 1837. He was alderman for Troy in 1847 and a member of congress for the term of 1853-1857. In 1863 he removed to New York city, where he became engaged in business in Wall street. Mr. Sage was reputed to be very wealthy, and was a director in a large number of corporations, among them being the Manhattan Railway Company, the Western Union Telegraph Company, the Fifth Avenue Bank, the Consolidated Coal Company, the Iowa Central Railway Company, the Missouri-Pacific Railway Company and the Pacific Mail Steamship Company.

MR. JOHN SALTAR, JR., died suddenly on July 12. Mr. Saltar was a graduate of the Rensselaer Polytechnic Institute, of Troy, N. Y., class of 1867. Upon graduation he accepted a position as civil engineer with an eastern railroad, later being appointed city engineer of Saratoga, N. Y., where he served some time, giving much satisfaction. Later his services were required by the government of Ecuador, where he was given charge of important works going on at that time. Upon the successful completion of this work Mr. Saltar again turned his attention to railroad work in the United States, finally accepting a position with the North Illinois Steel Works. This position he resigned in 1881 to accept the management of the western department of the Otto Gas Engine Works, Philadelphia, Pa. About seven years ago he was elected president of the company, which position he held at the time of his death. Under his efficient management all the larger sizes of the Otto engine were perfected and placed on the market. The name of John Saltar, Jr., is probably best known to the engineering world as the inventor of submarine engines. Mr. Saltar was an active member of the Masonic order and of the Western Society of Mechanical Engineers. The interment took place at Rockford, Ill., where Mr. Saltar was born.

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—Cedar Line Telephone Company, Amboy. $1,000.

DOVER, DEL.—People's Home Telephone Company, Chicago. $300,000.

PHILADELPHIA, PA.—Citizens' Electric Light Company, Philadelphia. $100,000.

COLUMBUS, OHIO—Moxahala & Bristol Railway Company, Moxahala. Increase of capital from $25,000 to $50,000.

DENVER, COL.—Stratton Telephone Company. $6,200. Incorporators: J. J. Pugh, A. J. Pugh and C. S. Wellman.

VINCENNES, IND.—White River Power Company. $500,000. President and general manager, Eugene Rush, Detroit, Mich.

NEWARK, N. J.—People's Light and Power Company. $500,000. Incorporators: Philip N. Jackson, Oliver W. Jackson and Joseph I. Conlon.

AUGUSTA, ME.—Ripley Telephone Company. $1,000. Officers: president, William H. Farrar, of Ripley; treasurer, Charles S. Boynton, of Ripley.

SPRINGFIELD, ILL.—Camp Point Electric Light and Power Company, Camp Point. $10,000. Incorporators: E. F. Hollister, F. H. Whitney and G. C. Gill.

BEACH CITY, OHIO—Beach City Home Telephone Company. $2,500. Incorporators: A. B. Wingate, Jacob Musand, O. E. Oberlin, J. M. Ramsey, M. W. Briggs and J. T. Hay.

INDIANAPOLIS, IND.—The Gary & Hammond Traction Company. $10,000. Directors: K. K. Knapp, William Duff Haynie, Gilbert R. Call, Mark Breeden and William Beye.

CLEVELAND, OHIO—The Cleveland Railway Promotion Company, Cleveland. $10,000. Incorporators: W. M. Hayden, A. W. Thomas, Max P. Goodman, F. B. Krause and C. F. Buxton.

SALT LAKE CITY, UTAH—The Alpine Light and Power Company, of American Fork. $100,000. Officers: A. J. Evans, president; D. C. Strong, vice-president; J. H. Clarke, secretary; S. L. Chipman, treasurer.

INDIANAPOLIS, IND.—Evansville, Princeton & Vincennes Interurban Railroad Company. $10,000. Directors: Henry W. Marshall, S. T. Murdock, Robert Todd, J. M. Barrett, W. V. Stuart, William Wallace and L. C. Neely.

RICHMOND, IND.—Ardmore Heat and Light Company. $200,000. Directors: John W. Smith, of Muncie, Ind.; L. G. Neely, of St. Mary's, Ohio; S. T. Murdock, of Lafayette, Ind.; J. D. S. Neely, E. R. Curtain, J. B. Kerr and E. J. Mair, all of Lima, Ohio.

AUGUSTA, ME.—North Dakota Independent Telephone Company. For the purpose of constructing and operating local and long-distance telephone lines. $3,000,000. Officers: president, L. J. Coleman, of Gardiner; treasurer, A. M. Macomber, of Augusta.

TRENTON, N. J.—Peoria Light Company. To purchase, hold and sell stocks, bonds and mortgages of railroad, street railway, electric light and gas companies. $3,500,000. Incorporators: R. S. Kearney, Jacob Heckma and William H. Carr, all of Jersey City.

JEFFERSON CITY, MO.—Versailles & Sedalia Railroad Company, of Versailles. To build a road six miles long within the county. $60,000. Incorporators: J. Applewhite, W. W. Fauss, J. M. Goodbar, J. C. Ottinger and S. W. Tate, of Memphis, Tenn.; G. D. Abell, Joel D. Hubbard and J. A. Petty, of Versailles.

SPRINGFIELD, ILL.—The De Kalb, Sycamore & Interurban Traction Company. To construct a road from De Kalb to Belvidere, from Sycamore to Elgin and from De Kalb to Yorkville, with branches from De Kalb to points in the counties of Boone, McHenry, Kane, Ogle, Lee, Kendall, La Salle and Dupage. $100,000.

GUTHRIE, OKLA.—Clinton, Cheyenne & Canadian Interurban Railway Company. To build from Clinton through Custer, Roger Mills and Kay counties to Canadian, in Hemphill county, Tex., and passing through Cheyenne in Roger Mills county, whence a branch line will be built through Greer county to Mangum. $1,000,000. Incorporators: C. S. Gilkerson, president; L. L. Collins, vice-president; R. V. Converse, secretary and treasurer; L. W. Pate and W. T. Bonner, directors, all of Cheyenne.

TELEPHONE AND TELEGRAPH.

MOBILE, ALA.—The Western Union Telegraph Company is reconstructing its line from Mobile to Bayou La Batre.

LITTLE ROCK, ARK.—The Southwestern Telegraph and Telephone Company is installing a line between Little Rock and Fort Smith.

NORWICH, CT.—The Southern New England Telephone Company has filed with the secretary of state a notice of an increase of its capital stock from $5,000,000 to $6,000,000.

KALAMAZOO, MICH.—E. W. Bowman and associates have incorporated the Citizens' Telephone Company with $250,000 capital. They purpose having a plant for 20,000 subscribers ready within a year.

HORNELL, N. Y.—Application has been made to the common council of Hornell by the New York & Pennsylvania Telephone and Telegraph Company for permission to put its wires under ground. The improvements will cost about $200,000.

MOULTRIE, GA.—The Moultrie Telephone Company has arranged for a larger telephone exchange, to meet the growing demand for service. The new exchange will accommodate 400 telephones, and will be put in in a short time.

SALT LAKE CITY, UTAH—Directors of the Rocky Mountain Bell Telephone Company are planning improvements which will involve an expenditure of $384,000. Increased business, necessitating a new switchboard and an additional amount of office room, is the explanation of the expenditure. The switchboard alone will cost $275,000.

NORWALK, OHIO—The Bell Telephone Company has begun the work of rebuilding its system in Norwalk. The contemplated improvements include the stringing of new wires all over the city, the erection of new poles where needed and the placing in the new offices of the company of a new switchboard. The work will necessitate the expenditure of many thousands of dollars.

PENN YAN, N. Y.—At the annual meeting of the Crosby & Barrington Telephone Company officers for the ensuing year were elected as follows: president, Charles E. Guile; vice-president, Howard S. Fullagar; directors, Isaac Crosby, Samuel I. Thayer, Thomas W. Windnagle, David Hoover, Herbert C. Ovenshire, Howard S. Fullagar and Charles E. Guile. The company now has thirty miles of pole lines and nearly sixty-five miles of wire.

CLEVELAND, OHIO—One of the improvements the United States Telephone Company will make with the $200,000 it will expend during the next year perfecting its system through Ohio is to be the main line it will complete between Cleveland and Wheeling. The line will be of special value to the company, because it can be used by the company's patrons through the southern and eastern parts of the state for connections with Pittsburg.

ALBANY, N. Y.—The Unadilla Valley Farmers' Telephone Company has been incorporated with the secretary of state to build and operate a line beginning at Trestle, Chenango county, and running thence to Mount Upton, Rockwell's Mills, White Store, Holmesville, and terminating at South New Berlin, with short lines connecting with several farmhouses in the vicinity, and one line running out from Rockwell's Mills to North Guilford, and there connecting with another line running to Oxford. The capital stock is $1,500, consisting of shares of $10 each. The directors are: C. D. Cornell, of Rockwell's Mills; Charles Prentice and John Rose, of Rockdale; A. C. Frate, of Guilford; I. J. Padgett and O. S. Meader, of South New Berlin, and N. S. Pearsall, of Mount Upton.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company will this season expend upwards of $150,000 in extending, enlarging and perfecting its system in the district of which Boise is the headquarters. The new operating rooms, switchboards and attachments of the Boise office, which have just been put in service, add to its capacity to the extent of 9,600 telephones. The long-distance equipment has been increased to permit of the employment of six additional operators. The company has completed, or has in course of construction, the reequipment of the offices at Nampa, Caldwell, Weiser, Payette and Council, Ida., and Ontario, Ore. These improvements result in adding two circuits between Boise and Caldwell, one between Caldwell and Weiser and two between Weiser and Council.

ELECTRIC LIGHTING.

GROTON, S. D.—The electric light plant at Groton is being enlarged.

ATLANTIC, IOWA—Work has been commenced on the erection of an electric light plant for the town of Lewis.

BELLE PLAINE, MINN.—Local capital will install an electric lighting plant for the borough of Belle Plaine. The company will be incorporated with a capital stock of $10,000.

TELLURIDE, COL.—The Telluride Power Company has contracted with the Westinghouse Electric and Manufacturing Company for some additions to its power transmission plant, consisting of two 7,500-horse-power generators and a number of transformers.

RACINE, WIS.—The explosion of a boiler destroyed the electric lighting plant at Camden, S. C., owned by Frank K. Bull, of Racine, Wis., causing a loss of $50,000. Mr. Bull sent his representatives to Camden with instructions to have the plant rebuilt. Camden is now without lighting and street railway service.

TONAWANDA, N. Y.—At a meeting of the directors of the Tonawanda Power Company and Suburban Power Company, held at the office of the Tonawanda Power Company, the following officers were elected: D. O. Mills, president; de Lancey Rankine, vice-president; F. L. Lovelace, secretary; W. Paxton Little, treasurer; F. M. Gordon, assistant treasurer.

KEWANEE, ILL.—All the holdings of the Kewanee Light and Power Company have been sold to the American Gas Company, of Philadelphia. In the transaction the electric light and gas plants and the heating plant, as well as the new ice-making plant, are included. The last two plants mentioned were the property of the Lighting and Heating Company, of Kewanee.

MEMPHIS, TENN.—A new electric light plant is being erected in Memphis, the present size of which will be 2,000 horse-power. The underground district of the city will be thoroughly wired this season for the distribution of the current generated. The plant will be owned by Edward G. Cowdery, of St. Louis, Mo., and several associates. It was erroneously stated in the issue of the ELECTRICAL REVIEW for July 14 that this plant would be owned and operated by the Laclede Gas Light Company.

SARATOGA SPRINGS, N. Y.—The stockholders of the Halfmoon Light, Heat and Power Company at their annual meeting elected the following directors: John C. Duncan, Edward H. Strang, Herbert O. Bailey, William L. Howland, Adelbert J. Harvey, Stephen Lee, William R. Palmer, of Stillwater; George Hudson, of Stillwater; G. F. Best, of Round Lake; William C. Tallmadge and John W. Gibson. The directors elected the following officers: president, John C. Duncan; vice-president, Edward H. Strang; secretary, Herbert O. Bailey; treasurer, William L. Howland.

CHATTANOOGA, TENN.—In order to facilitate the enlargement of the plant and the extension of its service the stockholders of the Citizens' Light, Heat and Power Company, of Montgomery, Ala., have organized a corporation under the name of the Citizens' Light and Power Company, and have taken stock in exchange for their holdings in the old. The change was made to take advantage of the new corporation laws of Alabama, which are more liberal. As with the old company the officers are: Alexander Rice, president; E. Meertieff, vice-president; P. R. Whiting, secretary, and J. L. Cobbs, treasurer.

PORTLAND, ORE.—All the electric wires and cables of the Portland General Electric Company will be placed under ground in the business districts of the city in the near future. Engineers of the corporation are now preparing plans for the proposed underground conduit system, which will be presented to the city council within the next sixty days. It is proposed that these plans, if acceptable, will be incorporated in an ordinance which will affect all electric light and power companies operating in the city. It is estimated that the outlay for placing the wires under ground will be not less than $500,000.

ELECTRIC RAILWAYS.

SAN ANTONIO, TEX.—The bonds have been sold and the contract let for the construction of an interurban electric line to run from San Marcos, Hays county, to Smithville, Caldwell county, a distance of about forty miles.

READING, PA.—A contract has been let for the construction of the trolley line from Trooper to Souderton, by the Montgomery Rapid Transit Company, to John Bane & Company, of New York. The road is a link of the Schuylkill Valley Traction Company.

EAST HOUGHTON, MICH.—At a meeting of the East Houghton village council a franchise was granted to the Houghton County Street Railway Company to build an extension of the street car line to East Houghton and as far as the easterly boundaries of the village.

HAGERSTOWN, MD.—A movement is on foot to build an electric road on South Mountain from Pen-Mar Park to High Rock, Quirauk, Brinkwood and Ragged Edge. Preliminary plans have been placed in the hands of Jason Bell and Simon Wiener, supervising engineers.

CHICAGO, ILL.—The Du Page County Railway, with principal office in Naperville, has been incorporated. The contemplated road is from Wheaton to Naperville. All of the incorporators are residents of the latter city, and are: W. F. Keeney, A. M. Royce, Alvin Scott, J. F. Royce and Samuel Mather.

GOSHEN, IND.—It is announced that the builders of the Indianapolis, Huntington, Columbia City & Northwestern Interurban Railway have secured $1,500,000 by bonding the property to the Central Trust Company, of Indianapolis, and will proceed at once and build the road from Goshen to Lake Wawasee, thirteen miles, equipping it for operation this fall.

WINCHESTER, VA.—The Frederick county board of supervisors has granted the application of the Winchester & Washington City Railway Company for a franchise for a right of way through Frederick county for its electric railroad, which is to be built between Winchester and a number of towns, connecting with the Southern Railway at or near Blue Mont, Loudoun county.

BENTON HARBOR, MICH.—President J. M. McMichael, of the Benton Harbor-St. Joseph Railway and Light Company, has given out a statement that his line will be extended from Benton Harbor to Kalamazoo, and that work will be started this fall. A line to Eau Claire will be in operation in August. Cars are now running as far as Tabor's resort, twelve miles from Benton Harbor. The line will go from Eau Claire to Dowagiac.

ROCHELLE, GA.—Some time ago J. A. J. Henderson, president of the Ocilla & Valdosta Railroad, made a proposition to the citizens of Rochelle that if they would subscribe for $16,000 of stock in the road he would agree to extend the line from Fitzgerald to Rochelle. The stock has been subscribed for and Mr. Henderson notified to that effect, which makes the road for Rochelle assured. Mr. Henderson expects to extend the road from Rochelle to Macon *via* Hawkinsville.

NEW HAVEN, CT.—The Consolidated Railway Company is preparing plans for an addition to its power plant in New Haven. The structure will be a brick building, one story high, sixty by seventy feet. Additions to the equipment, consisting of three 500-horse-power boilers, with a large generator set and condensers, will also be made. The company will likewise enlarge its power plant at Branford. The present building will be carried up two stories, and several new boilers of 200-horse-power capacity will be installed.

LEWISTON, IDA.—President G. W. Thompson, of the Lewiston Southeastern Electric Railroad and the Central Idaho Development Company, has wired from New York to his Lewiston representatives that the double enterprise has been financed by New York and Philadelphia capitalists. He says the sum pledged by them is $4,000,000, sufficient to build the road as far as projected and to develop the electrical power proposed by the latter company. The Lewiston Southeastern is being projected from Lewiston to Grangeville, Ida., a distance of ninety miles. It also intends to run a line from Westlake to Nez Perce. It is hoped to have twelve miles of the main line ready within the next month.

NEW CASTLE, PA.—The power-house of the New Castle & Harmony Electric Railroad, which will build a trolley line from New Castle to Pittsburg, will be at Eidenau, in Butler county.

EVANSVILLE, IND.—The Evansville & Henderson Traction Company, whose franchise was revoked by the Evansville board of public works because the line was not commenced within the specified time, will make application for a new franchise. Most of the surveying for the proposed road has been done. The line will be built by the Tennis Construction Company, of Cincinnati.

ROANOKE, VA.—The Twin City Electric Company has applied to the Roanoke common council for a franchise to operate an electric railway in the city. This company has been organized with the following officers: C. Markley, president; C. G. Cannaday, vice-president; A. L. Rife, secretary and treasurer, and M. A. Rife, general manager. The above, with G. T. Ellis and B. B. Dillard, compose the board of directors. The company proposes to extend the line to Salem.

ST. LOUIS, MO.—The Hillsboro, Kimmswick & Northern Railway Company, which has been chartered by the secretary of state, will connect with the United Railway Company's line at Jefferson barracks, and will unite that place with Hillsboro, Jefferson county, Mo., a distance of twenty-three miles. The company is capitalized at $300,000. The incorporators are: Charles A. Gutke, H. W. Gutke, Anthony F. Furrer, James J. Ring, Charles F. Crane and Lee A. Hall.

HARTFORD, CT.—Judge Robinson, of the Hartford County Superior Court, has authorized the Stafford Springs Railway Company, which is owned by the Consolidated Railway Company, to transfer certain rights under its charter to the Hartford & Springfield Street Railway Company. The franchise which is to be transferred will permit the Hartford & Springfield system to extend a line from Somerville to Stafford, connecting with the road which the Consolidated Railway Company is to build from Rockville to Stafford Springs.

BALTIMORE, MD.—Alva A. Lamkin, counsel for the Kent Traction Company, which proposes building a trolley line between Tolchester and Chestertown, has been notified that practically all the right of way has been secured, and that work will shortly be started on the road. The route surveyed is about ten miles long, and it is intended to locate the power-house about midway between the two places, at Fairlee. The original intention was to use gasoline motor cars, but after a careful investigation the promoters decided upon electricity as a motive power, and it is now proposed to have the company sell current as well as operate the railway. The capital stock of the Kent Traction Company is $200,000. The line which it will build will be for freight as well as passenger use.

SYRACUSE, N. Y.—Members of the Vanderbilt-Andrews syndicate of electric railroads have been elected to the directorate of the Rochester Electric Railway Company, said to be the most profitable electric line in western New York. It is leased for $16,000 a year to the Rochester Railway Company, which pays a dividend of eight per cent on its $200,000 capital stock and has a surplus of $42,500. The road runs to Ontario Beach. The directors elected are: Horace E. Andrews, of Cleveland, Ohio, president of the Rapid Transit Company; W. K. Vanderbilt, Jr., E. V. W. Rossiter, John Carstensen, W. C. Brown and W. J. Wilgus, New York Central officials; John J. Stanley, general manager of the Rapid Transit and the Mohawk Valley companies; A. H. Harris, C. T. Chapin, G. E. Roth, G. A. Holister, W. M. Eaton and W. C. Barry, of Rochester.

PERSONAL MENTION.

MR. M. H. DONAHUE, who has been manager of the Postal Telegraph Company at Oswego, N. Y., has resigned to accept a position in the electrical department of the Pennsylvania Railroad at Olean, N. Y.

MR. EDGAR JAY RAUCH, of Norwalk, Ohio, has been appointed superintendent of the Saginaw & Bay City Railways and the Interurban line. Mr. Rauch was formerly general superintendent of the Canton-Akron Railway, the Canton-New Philadelphia Railway and of the Tuscarawas Traction Company, a system of Ohio interurban roads.

MR. R. M. SEARLE, general manager of the Westchester Lighting Company, with offices at Mount Vernon, N. Y., has been appointed general manager of the Rochester Railway and Light Company, succeeding Mr. W. M. Eaton, who is relieved of these duties to take up the work connected with the vice-presidencies of the Rochester Railway and Light Company and the Rochester Railway Company.

MR. E. W. T. GRAY, who has for years been manager of the New York sales office of the Westinghouse Electric and Manufacturing Company, resigned recently to take up commercial work in another field. Mr. Gray's decision to sever his connection with the Westinghouse company was received with great regret by the management, he having been one of the pioneer employés of the company. Mr. Gray began his work with the Westinghouse company about the year 1890, starting in the laboratory of its original works in the heart of the city of Pittsburg. Later he took up installation work for the company, installing the first railway motors the company made, on cars in Lansing, Mich., about the year 1901. Following a short period spent in installation work, Mr. Gray was called by the company to its sales organization, with headquarters at Pittsburg. In 1898 Mr. Gray received the appointment of manager of the New York office. Mr. W. C. Webster, who succeeds Mr. Gray as manager of the New York sales office, has a broad general knowledge of the company's commercial policy, and on account of his close association with the sales department in the past enjoys a personal acquaintance with the entire sales force, which should be of great advantage to him in his new work. Mr. Webster entered the employ of the company in 1898, and has always been identified with the sales department.

MR. FRANK C. MASON, the well-known superintendent of the police telegraph system in Brooklyn, N. Y., has retired from active service and is receiving the congratulations of his many friends throughout the electrical industry. Mr. Mason is gifted with a rare faculty of making and holding friends, and the universal wish is expressed that he will now enjoy the fruits of his labors at the beautiful farm upon which he will live, near Utica, N. Y. The Brooklyn *Standard Union*, commenting upon Mr. Mason's retirement, speaks as follows: "Mr. Frank C. Mason, who for twenty years had been superintendent of the police telegraph system in Brooklyn, has received several big offers from electrical companies in Greater New York since the latter knew of his retirement from the police department. He will not accept any of them, however, he says, although in most cases the salary offered is greatly in advance of what he had been receiving from the city. He declares that he will not enter into business of any character. By his present plans Mr. Mason will try to obtain plenty of much needed rest, spending eight months at his old homestead in Washington Mills, N. Y., four miles south of Utica, where he was born and raised, and the remaining four of the year in Greater New York, in order to keep in touch with electrical matters and with his old friends. At the time of his appointment to the position in the police department from which he has just been retired, Mr. Mason led the list in a competitive examination for the office. He was appointed March 11, 1884. The commissioner of police at the time was John N. Partridge, who was serving during Seth Low's second administration as mayor of Brooklyn. The telegraphic equipment in the police department was far from being as perfect then as it is now. In fact it was even crude. Communication between the precincts and headquarters was maintained by means of the dial telegraph instruments. There were nine precincts then to the thirty-three in existence now. All these are furnished with modern telephone and telegraph facilities, mainly through the work of Mr. Mason. Mr. Mason was manager for the Atlantic & Pacific Telegraph Company in Poughkeepsie before he came to Brooklyn. His early education was obtained in the public schools of Utica. As a lodge member Mr. Mason is very widely known. He belongs to the Commonwealth Lodge 409, F. and A. M.; the Scottish Rite bodies, Masonic, of Brooklyn; Kismet Lodge, of the Mystic Shriners, and is also a member of the Brooklyn Lodge of Elks. In 1886 he organized the International Association of Municipal Electricians in the Clarendon Hotel. This organization is flourishing to-day, and contains some of the best-known municipal electricians in the United States and Canada. Mr. Mason also organized the Long Island Telephone Company, from which sprung, later on, the present New York & New Jersey Telephone Company."

NEW PUBLICATIONS.

THE SUBMARINE *VERSUS* THE SUBMERSIBLE—The paper by Simon Lake, entitled "The Submarine *versus* the Submersible," has been reprinted from the *Journal of the American Society of Naval Engineers.*

PRATT INSTITUTE FREE LIBRARY LIST OF BOOKS ON ELECTRICITY—Pratt Institute, Brooklyn, N. Y., has published an annotated list of books on electricity, in connection with the Pratt Institute free library. This list will be sent to any address on receipt of request.

NEW YORK ELECTRICAL SOCIETY—The address entitled "Fundamental Principles of Gas Engines and Gas Producers," delivered by Robert T. Lozier before the 257th meeting of the New York Electrical Society, February 21, 1906, has been reprinted as No. X of the society's transactions.

TRANSACTIONS OF THE ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY—The Association of Civil Engineers of Cornell University has published its transactions for 1905-1906. These include addresses by non-resident lecturers, miscellaneous papers, and a list of members of the association. The frontispiece is a reproduction of the Cornell inter-college baseball challenge cup, won in 1905 by the College of Civil Engineering.

JOURNAL OF THE WORCESTER POLYTECHNIC INSTITUTE—The July issue of the *Journal of the Worcester Polytechnic Institute* is designated as the commencement number. The contents include the commencement address, entitled "Technical Education in Relation to Industrial Development," by Charles G. Washburn, and the commencement lecture delivered by Leonard P. Kinnicutt, entitled "Sanitary Science and the Public Health." Reports are given of the thirty-third annual dinner and meeting of the Alumni Association and of the reunions of the classes of 1871, 1894, 1895, 1896 and 1902. In addition to this there are institute notes and alumni notes.

THE TECHNOLEXICON OF THE SOCIETY OF GERMAN ENGINEERS—About 2,000 firms and individual collaborators in Germany and abroad are assisting in the compilation of the "Technolexicon of the Society of German Engineers." This will be a universal technical dictionary in three languages—English, German and French. The work of preparation was commenced in 1901. Over 3,000,000 word-cards have been collected. Alphabetizing has so far advanced that printing will begin early in 1907. The work will be printed and published by the well-known firm of J. J. Weber, Leipsic. The editor-in-chief is Dr. Hubert Jansen, Berlin (N. W. 7), Dorotheenstrasse 49.

THE MACHINE TOOL POCKET LIST—The "Machine Tool Pocket List," formerly published by the Angus Ballard Company, has been purchased by the George H. Gibson Company, New York city. The size of the book will be increased from three and one-half by six inches to four by nine inches. The buyers' finding list of machine tools and supplies will be made more complete and definite, although the present list covers over a thousand firms and about 2,000 articles and types of tools. Brief articles of interest to manufacturers of machinery will be added, and the list will be combined with *Manufacturing*, a journal in which the George H. Gibson Company describes and lists important patents and other industrial opportunities.

CARBON BRUSHES—A practical treatise on the use of carbon brushes for electric motors and generators, entitled "Carbon Brushes," by J. S. Speer, has been published by the Speer Carbon Company, St. Marys, Pa. This is one of the most interesting and instructive treatises which has been published upon the subject. The work includes a study of the functions of carbon brushes, the elements which are necessary for successful operation, and a chapter on commutator troubles. In addition to this there is given a series of curves showing graphic results of heat tests, brush friction tests, brush voltage drop tests, brush tension tests, contact resistance tests, wattage loss tests and coefficient of friction tests. The chapter concerning contact devices for carbon brushes is very interesting and indicates very clearly the close study which the author has given to this important subject.

ELECTRICAL SECURITIES.

While speculation during the past week was very dull, prices made general gains as against a week ago, and a higher level is evident all along the line. This rally was made despite the fact that there was no increase in Amalgamated Copper's dividend, and in spite of the sensational rumors of panic at St. Petersburg and declines in Russian bonds. A number of very favorable railroad earnings were reported, notably Baltimore & Ohio showing a gross gain for the fiscal year of $9,702,000, and a net gain of $4,897,000. Missouri Pacific for May reported a net gain of $303,000. Further evidence of the prosperity of the railroads is provided in the Interstate Commerce Commission's preliminary report, to the effect that for the fiscal year just ended the railroads show a gross gain of ten per cent over the $2,073,000,000 reported in 1905. Trade reports also reflect prosperity in the iron and steel industry.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 21.

New York:	*Closing.*
Allis-Chalmers common	16½
Allis-Chalmers preferred	45
Brooklyn Rapid Transit	74¾
Consolidated Gas	139
General Electric	163
Interborough-Metropolitan common	37¾
Interborough-Metropolitan preferred	76¾
Kings County Electric	165
Mackey Companies (Postal Telegraph and Cables) common	71½
Mackey Companies (Postal Telegraph and Cables) preferred	71¼
Manhattan Elevated	148
Metropolitan Street Railway	103
New York & New Jersey Telephone	125
Western Union	92
Westinghouse Manufacturing Company	151

Boston:	*Closing.*
American Telephone and Telegraph	130¼
Edison Electric Illuminating	240
Massachusetts Electric	68
New England Telephone	120
Western Telephone and Telegraph preferred	90

The directors of the Edison Company, of Boston, have declared the regular quarterly dividend of 2½ per cent, payable August 1, to stockholders of record at close of business July 18.

The Western Telephone and Telegraph Company has declared a regular semi-annual dividend of 2½ per cent on the preferred stock, payable August 1 to stockholders of record July 20. Books will be closed from July 20 to July 31, inclusive.

The instrument statement of the American Telephone and Telegraph Company for the month of June is as follows: gross output, 217,243; returned, 54,973; net output, 162,270. For the six months of 1906 ending June 30 the net output was 803,522. The total now outstanding is 6,501,780.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	68
Electric Storage Battery preferred	68
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	29¼
United Gas Improvement	83½

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	135
Metropolitan Elevated	68
National Carbon common	81¾
National Carbon preferred	117
Union Traction common	4
Union Traction preferred	14

At the regular July meeting of the directors of the Metropolitan Elevated Railroad Company, of Chicago, the dividend question was not discussed, and the meeting was devoted to purely routine matters. The next meeting will be held on August 20, and it is generally understood that the declaration of a dividend on the preferred stock will not be deferred longer than that time. The earnings this year indicate the probability of a surplus closely approximating $1,000,000 by September 1.

INDUSTRIAL ITEMS.

THE AJAX LINE MATERIAL COMPANY, Chicago, Ill., is sending out a sample of "Ajax" rainproof rope. Each strand is waterproofed before being braided into a solid rope.

THE MICHIGAN CENTRAL RAILROAD, "The Niagara Falls Route," is sending out some interesting and artistic literature respecting Topinabee and Mullet Lake, Mich., popular summer resorts reached by this road.

THE ABBE ENGINEERING COMPANY, 220 Broadway, New York city, has published a handsome catalogue descriptive of its complete line of pebble mills and various other machines for the reduction of all hard and soft materials.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., announces that a report from its San Francisco (Cal.) office states that, as nearly as can be determined during the present unsettled state of that city, the number of its office recently opened there is 206 First street.

THE OSWEGO BOILER AND ENGINE COMPANY, Oswego, N. Y., has issued bulletin No. 40, dealing with steel tanks. This describes and gives the dimensions of circular black steel tanks for gas, gasoline, air and water. These are to be used for blowoff, receiving, drip, pressure or hot-water tanks.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., has ready for distribution a booklet describing its mine telephone system. In addition to the descriptive matter and illustrations there are a number of testimonials from different mining companies commendatory of this system.

ROYLE & AKIN, Ossining, N. Y., wire manufacturers, have issued a very practical and substantial wire gauge, clearly printed on celluloid. This wire gauge is in vest-pocket size, and will be found of great utility by electricians in general. The company will be pleased to send one of these wire gauges to any one interested in the subject, upon request.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., reports a greatly increased demand for the "Sunbeam" lamp. This is the eighteenth consecutive year of the sale of this lamp. The company announces that it will answer promptly all enquiries concerning this product, and that it is in a position to furnish without delay lamps suitable for all circuits.

KEOUGH BROTHERS & COMPANY, Boston, Mass., have appointed V. C. Gilpin, 120 Liberty street, New York city, their general sales agent. Among the electrical specialties manufactured by Keough Brothers is the Keough cord-grip, a device that fulfills the requirements of the underwriters and permits the use of reenforced cord with one-eighth-inch socket.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in connection with the Cleveland convention of the National Electrical Contractors' Association, issued a unique folder in the shape of a railroad ticket calling attention to the bulletins issued by the company, the list of district offices and other information concerning the company's products.

THE COOPER HEWITT LAMP COMPANY, Pittsburg, Pa., has published a handsome booklet entitled "The Economical Lighting of Industrial Plants." In addition to the text, which gives a very careful discussion of the advantages of the Cooper Hewitt mercury vapor lamp, there are numerous illustrations showing the practical application of this form of lighting to industrial plants.

THE STANDARD VARNISH WORKS, 29 Broadway, New York city, announces that it has installed, for experimental purposes, a complete plant of the Passburg system, and is now in a position to work out practically all problems in the vacuum drying and impregnating of armature and field coils with solid compounds. Any one wishing to test this method practically may send the company small armatures, armature coils or field coils, which the company will dry under vacuum and impregnate with a solid compound free of charge and return. Coils submitted should be marked "Insulating Department, Standard Varnish Works, 29 Broadway, New York city," and freight and express charges prepaid.

M. W. DUNTON & COMPANY, Providence, R. I., announce the opening of an office for the sale of "Nokorode" soldering paste throughout the state of Indiana, with Alpha H. Kling, Peru, Ind. Mr. Kling carries a large stock of "Nokorode" in all sizes of packages, and is prepared to accept orders for immediate shipment at prices quoted from the home offices, thus saving transportation charges from Providence to Indiana.

W. S. BARSTOW & COMPANY, 56 Pine street, New York city, are the engineers for the New Jersey Company, Matawan, N. J., making improvements and additions to its plant. The remodeled plant will have double the capacity of the old one. In order to meet the increased shop requirements a large dock will be built on Matawan creek and a new power-house will provide for electric drive and lighting throughout the plant.

THE DE LA VERGNE MACHINE COMPANY, foot East One Hundred and Thirty-eighth street, New York city, the sole licensee for the manufacture of the Koerting gas engine and producer in the United States, has issued a ten-page folder describing the Koerting four-cycle gas engine and suction producer. These engines have met with remarkable success in Europe, where a large number have been installed in municipal lighting plants, factories and other places.

THE CATARACT ELECTRIC SUPPLY COMPANY, Buffalo, N. Y., with offices and store at 1113 West Swan street, carries a large stock of general electrical supplies and small fittings of all descriptions, as well as dynamos and motors and heavier electrical machinery. D. F. Potter is the general manager of the company, and the board of directors is comprised of the following well-known men: Charles R. Huntley, William R. Huntley, Daniel T. Nash and de Lancey Rankine.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued several new catalogues. Catalogue No. 19,062 deals with motor starters for speed control by field regulation; No. 19,063, motor starters equipped with tight casings; No. 19,064, theatre dimmers; No. 19,067, electric soldering irons. A discount sheet for motor-starting rheostats, armature speed controllers, etc., has also been issued, and the company is sending out a number of index leaves to facilitate the filing of its trade literature.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has received orders for gas engines aggregating 68,000 horse-power. Among these are the following: Illinois Steel Company, 15,000 horse-power; Homestead plant of the Carnegie Steel Company, 4,000 horse-power; Indiana Steel Company, 35,000 horse-power. The company is also building large gas-blowing engines for the United States Steel Corporation. During the month of June the orders received by the Allis-Chalmers Company were the largest in its history, aggregating over $3,000,000.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a unique blotter calling attention to "Okonite," printed in two colors, which is causing favorable comment throughout the trade. The inscription reads as follows: "By using this blotter on an order for Okonite you are entitled to a life membership in the Society of Satisfied Users, composed exclusively of those who use and endorse Okonite as the standard for rubber insulation." The company suggests that any one desiring to become a member of this society write for one of these blotters.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution bulletins Nos. 3110, 3203, 3204 and 3802 describing and illustrating, respectively, single-phase induction motors with worm-gear speed-reduction device, one-twentieth to one-fourth horse-power; direct-current motors with worm-gear speed-reduction device, bi-polar enclosed types, one-twentieth to one-fifth horse-power; bi-polar enclosed motors for direct current, class 412 and 422, one-twentieth to one-fifth horse-power, and motor-driven air-pumps for direct and alternating current.